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ABSTRACT

This guide is intended for use in introducing students to the operation and applications of computer-aided drafting (CAD) systems. The following topics are covered in the individual lessons: understanding CAD (CAD versus traditional manual drafting and care of software and hardware); using the components of a CAD system (primary and other input devices and computer configuration); initializing a CAD system; using input devices (keyboards and auxiliary input devices); setting drawing parameters (setting page size and selecting scale, units, and font); storing and retrieving data; creating a drawing with a CAD system (terms related to drawing with CAD, basic entity insertion, secondary entity creation [cross-hatching], and drawing manipulation); text insertion (terminology for inserting text, and dimensions, notes, and ancillary text); editing existing drawings; using a CAD library, using output devices (printers, plotters, and laser printers); and exiting a CAD system (logging off). Each lesson contains some or all of the following: a statement of the scope of the unit, lesson objectives, an information assignment, suggested resources, an introduction, a lesson outline, a summary and conclusion, interaction items (questions to stimulate student interaction during the lesson), classroom and laboratory activities, and evaluation items. Appendixes include guides to using a disk operating system (DOS); the AUTOCAD, MATC CAD, and CADKEY software packages; a glossary; and a bibliography. (MN)

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# COMPUTER AIDED DRAFTING

## Instructor's Guide

Michael A. Henry

Produced by the Instructional Materials Laboratory
University of Missouri-Columbia
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July 1987

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## PREFACE

This module was developed through the combined efforts of dedicated individuals involved in educational programs in drafting. Educators from adult preparatory, secondary education, and postsecondary vocational programs cooperated in the development of the content outline (which identifies the entry-level tasks a CAD operator would perform) from which this module ultimately evolved.

As members of the advisory committee struggled with the issue of generic vs. system-specific lesson plans, there was a general consensus that in view of the objective of the project, which was to provide a basic groundwork in CAD for drafting students (who may or may not have had prior computer experience), development of generic instructional materials was the appropriate choice. Furthermore, attempting to address all of the CAD system software currently on the market would have been a complicated undertaking far beyond the scope of this project. Committee members agreed that to maximize the impact of lessons demonstrating system operation procedures, drafting instructors should modify or augment those lesson plans by customizing them to the school's CAD system. One way to accomplish this would be to provide students with system-specific handouts covering the basic operations of the CAD software used in the classroom. Refer to the appendices of this guide for sample informational handouts which outline some of the basic operation procedures for several widely-used CAD software packages.

Once the generic vs. system-specific dilemma was resolved, units and lessons were developed and then fieldtested to assure usability in the classroom. The end product is an instructional module to assist drafting educators to facilitate learning in the area of computer aided drafting.

The lesson plans allow the curriculum guide to be utilized in short, manageable segments. Each lesson contains the following components:

**SCOPE OF UNIT**

A teacher-centered statement that includes the goals of the unit; allows the reader to see the comprehensive content of each lesson

**LESSON OBJECTIVES**

A listing of skills the student will be able to perform as a result of the lesson; provides the basis for evaluation

**INFORMATION ASSIGNMENT**

An assignment for which the student is responsible

**REFERENCE**

Resources the instructor uses to support the unit content

**INTRODUCTION**

A statement that sets the stage for learning of the content; tells the student why the lesson is important

**OUTLINE**

The content of the lesson; may be informative in nature or it may be the steps of a procedure to learn a skill

**SUMMARY AND CONCLUSION**

Reassimilates all of the information that was included in the content of the lesson; ties all of the information together in a comprehensive overview; purpose is to reinforce learning by summarizing the major components of the lesson

**INTERACTION ITEMS**

Questions intended to stimulate and encourage student interaction during the unit presentation; allow the instructor to build on students' previous learning as well as dispel any misconceptions

**CLASSROOM/LABORATORY ACTIVITIES**

Activities designed to reinforce learning; allow students to interact with the new information or materials contained in the lesson

**EVALUATION ITEMS**

An exercise designed to measure the accomplishment of the lesson objectives; may be a written evaluation or skills demonstration

The module becomes individualized when the instructor includes his/her program's philosophy and unique teaching style. Additional content may be added to increase the scope of the unit if it better serves individual programs.

The dedication with which this course was developed reflects the sincere desire of the CAD advisory committee and fieldtesters to provide a solid basic educational foundation for beginning students in computer aided drafting.

## Introduction

In 1957 Robert A. Heinlein wrote a speculative story about a device called "Draftin' Dan." The machine was described as having an "economy of linkages using circuits to reduce the number of moving parts to a minimum." It even used an IBM Selectric typewriter for the keyboard chassis. "Draftin' Dan" was operated by pushing a combination of keys to produce horizontal, vertical, or curved lines, and "with a little practice you could even make a reasonable copy of your own signature."

Mr. Heinlein's device was supposedly patented in the year 2001. However, it is now the mid-1980s and "Draftin' Dan" is a relatively common device. A keyboard (which often resembles an IBM Selectric) is hooked (interfaced) to a computer (with circuits that reduce the number of moving parts to a minimum), and the drawings are produced by pressing a combination of keys and digitizing points. The "economy of linkages" often extends all the way to the manufacturing process, connecting "Draftin' Dan" directly to machines that produce the actual manufactured item (CAM).

In the story, a drafter could learn to operate "Draftin' Dan" in just a few hours. Contemporary computer aided drafting devices aren't quite that simple. As in any other subject, organized instructional guides are required. The student should learn from performance-based curriculum following current industry requirements. These lesson plans are intended to be a guide for adding a computer aided drafting program to an existing drafting curriculum.

An employable CAD operator must first be a competent "traditional" drafting technician. With the addition of CAD to existing programs, there may be a tendency to drop or de-emphasize other aspects of traditional drafting such as geometric construction principles. CAD is not a substitute for any area of traditional drafting. The best-trained traditional drafters make the best CAD operators. It is true that the basic method of drawing creation is changing, but the basic principles of drafting have been in use since Cheops and the Great Pyramids and will continue to be used far beyond the 2001 of Heinlein's imagined (or our real) future.

Michael A. Henry

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LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I : UNDERSTANDING CAD

SCOPE OF UNIT:

Upon completion of this unit, the student will be oriented to the computer aided drafting environment. The first lesson will outline the differences between manual (traditional) and computer drafting and the second lesson will discuss the care of hardware and software.

INFORMATION TOPIC: X OR DEMONSTRATION:

A COMPARISON OF MANUAL (TRADITIONAL) DRAFTING AND COMPUTER AIDED DRAFTING
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Identify characteristics of CAD.
2. Identify advantages of CAD.
3. Identify disadvantages of CAD.
4. Identify misconceptions about CAD.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. TM 1: Drafting...Changes in Drawing Production
2. TM 2: Speed--An Advantage of CAD

INFORMATIONAL ASSIGNMENT: (Student)

The student should read the introductory information that pertains to the CAD system being used in the classroom. Additional reading may be assigned (at instructor's option) from an appropriate textbook.

REFERENCES: (Instructor's Additional Information)

Manuals and reference materials pertaining to classroom CAD system.

See bibliography.

Bertoline, Gary R. Fundamentals of CAD. Albany, New York: Delmar Publishers Inc., 1985.

Hindhede, Uffe, et al. Machine Design Fundamentals. New York: John Wiley and Sons, 1983.

INTRODUCTION:

Computer aided drafting is not a "future technology" to be learned if you get the opportunity. It is not something used occasionally only by large companies. Computer Aided Drafting is here now, and there is a shortage of trained operators.

This lesson discusses the "CAD environment," including the differences between CAD and traditional drafting, as well as the advantages and disadvantages of computer drafting.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I: UNDERSTANDING CAD

OUTLINE: (Key Points)

I. Introduction to Computer Aided Drafting (CAD)

A. A CAD system is another tool to be used by the drafter/designer. (TM 1)

1. At one time the elbow drafting machine was a major innovation in drafting. (II-1)

2. What were once new types of drafting tools are becoming commonplace.

a. Wood pencils; lead holders; automatic pencils

b. Ames Lettering Guide

3. The CAD system simply offers another method/medium for producing engineering documents.

a. Engineering drawings can no longer be considered just "plans."

b. Drawings are documentation for the manufacturing process.

B. A CAD system is analogous to the word processor in that the operator must still possess "traditional" skills.

1. To use a word processor you must have typing skills.

2. To use CAD the drafter/designer must understand and be able to use traditional projection techniques, dimensioning, etc.

II. Advantages of CAD

A. Speed (TM 2)

1. Lettering can be produced as much as 100 times faster than a drafter can letter freehand.

2. Corrections can be made in easy steps.

a. Delete incorrect information

b. Insert correct information

c. Modify existing information

3. Filing operations are simplified - drawings can be retrieved simply by entering the drawing file name or number.

4. In general, CAD is 5 to 25 times faster than manual drafting.

a. Some applications may be 100 times faster.

b. Some applications may produce little or no timesaving compared to manual drafting.

c. Operator speed increases through practice.

B. Consistency, accuracy, and neatness

1. No two drafters draw or letter in exactly the same way.

2. Reading a scale is prone to human error. (II-2)

a. Fatigue

b. Carelessness

c. Hurrying to meet a deadline

3. Accuracy in a plotted (CAD) drawing is limited only by the output device. (Many plotters are accurate to within .005 inches.)

C. Automated features eliminate duplication of effort and redrawing.

1. Symbol library can be created by the operator to automatically draw parts or symbols that are frequently used.

a. A bolt can be drawn once and copied into a number of other locations on the drawing.

b. Standard symbols such as geometric tolerancing symbols or electronic symbols can be inserted quickly and easily.

2. A repeated pattern (a hole pattern, for example) can be copied into multiple locations on a drawing.

3. A symmetrical drawing can be created by drawing one half of the part and copying (mirroring) the other half.

4. Once a drawing has been stored, it never has to be drawn again.

5. A new drawing can be made from an existing drawing simply by making corrections/alterations and storing the drawing with a new identification name or number.

III. Disadvantages of CAD

A. Cost

1. Setting up a CAD system

a. Hardware can cost from $2,500 to $1,000,000 (or more).

b. Cost of re-educating employees

2. Maintaining a CAD system

a. Requires availability of specialized maintenance personnel (usually on agreement from the manufacturer).

b. Cost of storage media (blank disks, tapes etc.)

B. Downtime (computer malfunctions) - if the computer is not operating, the entire engineering department may be unable to work until the system is repaired.

C. Shift work - to optimize the investment in the system many companies are adding second and third shifts to CAD departments.

IV. Common Misconceptions About CAD

A. "CAD is making the occupation of drafter obsolete. Computers will do all the work." (II-3)

1. CAD systems do not do drafting work automatically.

2. A trained operator is required to use the system.

3. CAD systems are simply another tool for drafters to use.

4. Jobs that may be eliminated (e.g., tracer) are already almost obsolete anyway.

5. A CAD system frees a drafter from the tedium of lettering and line work, allowing more time for creative input.

B. "A CAD operator must be a programmer in addition to a drafterer." (II-4)

1. CAD manufacturers normally supply all the programming needed for a CAD system.

2. A drafter does not need to know anything about programming.

C. "Drafting students no longer need to know any traditional drafting skills." (II-5)

1. A trained drafter is necessary for CAD system operation.

2. The rules don't change, just the media.

3. Good projection, construction, dimensioning and visualization skills are essential to CAD operation.

4. A CAD system simply helps the drafter to do the same job faster.

V. Summary and Conclusion

A. Introduction to Computer Aided Drafting

B. Advantages of CAD

C. Disadvantages of CAD

D. Common misconceptions about CAD

Computer Aided Drafting is considered to be a relatively new technology (since about 1950) although it is now firmly established. Traditional drafting positions will probably become increasingly rare and CAD positions more common. For any drafting student, the time to learn CAD is now.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I : UNDERSTANDING CAD

INTERACTION ITEMS: (Review Items)

1. How was the drafting machine an improvement over older drafting methods?

2. What are some of the things that can cause errors on a drawing?

3. Many people think that CAD is going to eliminate drafters. What do you think?

4. Are drafters going to need to be computer programmers?

5. What skills will a drafter not need to learn now that CAD is available?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. The students could examine local want ads, looking for openings for CAD operators. There are many job titles and job classifications in CAD, and an activity like this would enable the students to become familiar with the job market and types of training required.

2. The students could "race" the instructor in the completion of small, simple, identical drawings. The students would use traditional drafting methods and the instructor would use CAD. (NOTE: The instructor must not be a beginner on the CAD system being used.) A variety of drawings could be chosen to demonstrate that in some applications, CAD is not faster.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I: UNDERSTANDING CAD

EVALUATION ITEMS:

For each of the following write "T" if the statement is true or "F" if it is false.

1._____ A CAD system is another tool to be used by the drafter/designer.

2._____ No new drafting tools have been developed for many years.

3._____ The CAD operator does not need to know anything about drafting.

4._____ The CAD operator must understand projection techniques and dimensioning.

5._____ Lettering on a CAD system can be up to 100 times faster than hand lettering.

6._____ In general, CAD is faster than traditional drafting.

7._____ Plotted drawings are only slightly more accurate than drawings done by hand.

8._____ CAD systems have no disadvantages to be considered other than cost.

9._____ Once a CAD drawing is created and stored it never has to be drawn again.

10._____ A trained drafter is necessary for CAD system operation.

Circle the correct answer.

11. Computer aided drafting is
    a) Not expensive
    b) Eliminating all drafting jobs
    c) Not future technology
    d) Not for trained drafters

12. Traditional drafting skills are
    a) No longer needed
    b) Still required
    c) Not needed as much
    d) Different for CAD

13. Lettering using CAD can be
    a) Slower than by hand
    b) 100 times faster than lettering by hand
    c) Not as good as hand lettering
    d) None of the above

14. Filing operations on CAD
    a) Are simpler than traditional methods
    b) Require more building space
    c) More complicated than traditional methods
    d) Not any different than traditional methods

15. Consistency, accuracy, and neatness with CAD are
    a) No better than with traditional drawing methods
    b) Prone to human error
    c) Affected by scale
    d) Limited only by the output device

16. In general, CAD operations are
    a) Not always useful
    b) Not gained by practice
    c) Faster than traditional methods
    d) Still in the future

17. A symbol library is
    a) Used for copying drawings
    b) Only for new drawings
    c) A collection of often used patterns
    d) Duplicated within a drawing

18. The impact of CAD will be to
    a) Eliminate the need for anyone to learn drafting
    b) Put all the drafters out of work
    c) Require all drafters to learn programming
    d) Require that drafters learn new skills

LESSON PLAN: 1

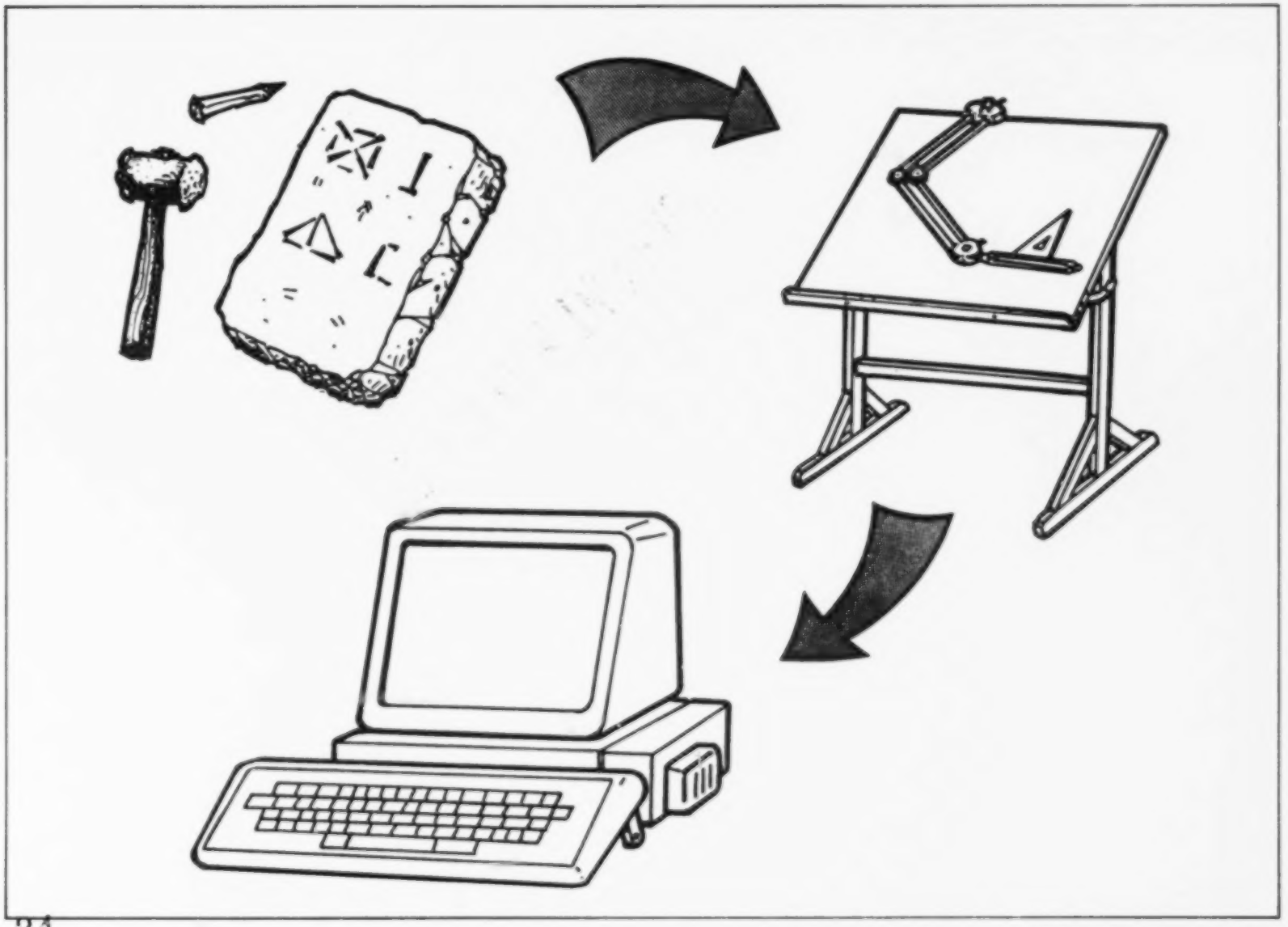
COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I: UNDERSTANDING CAD

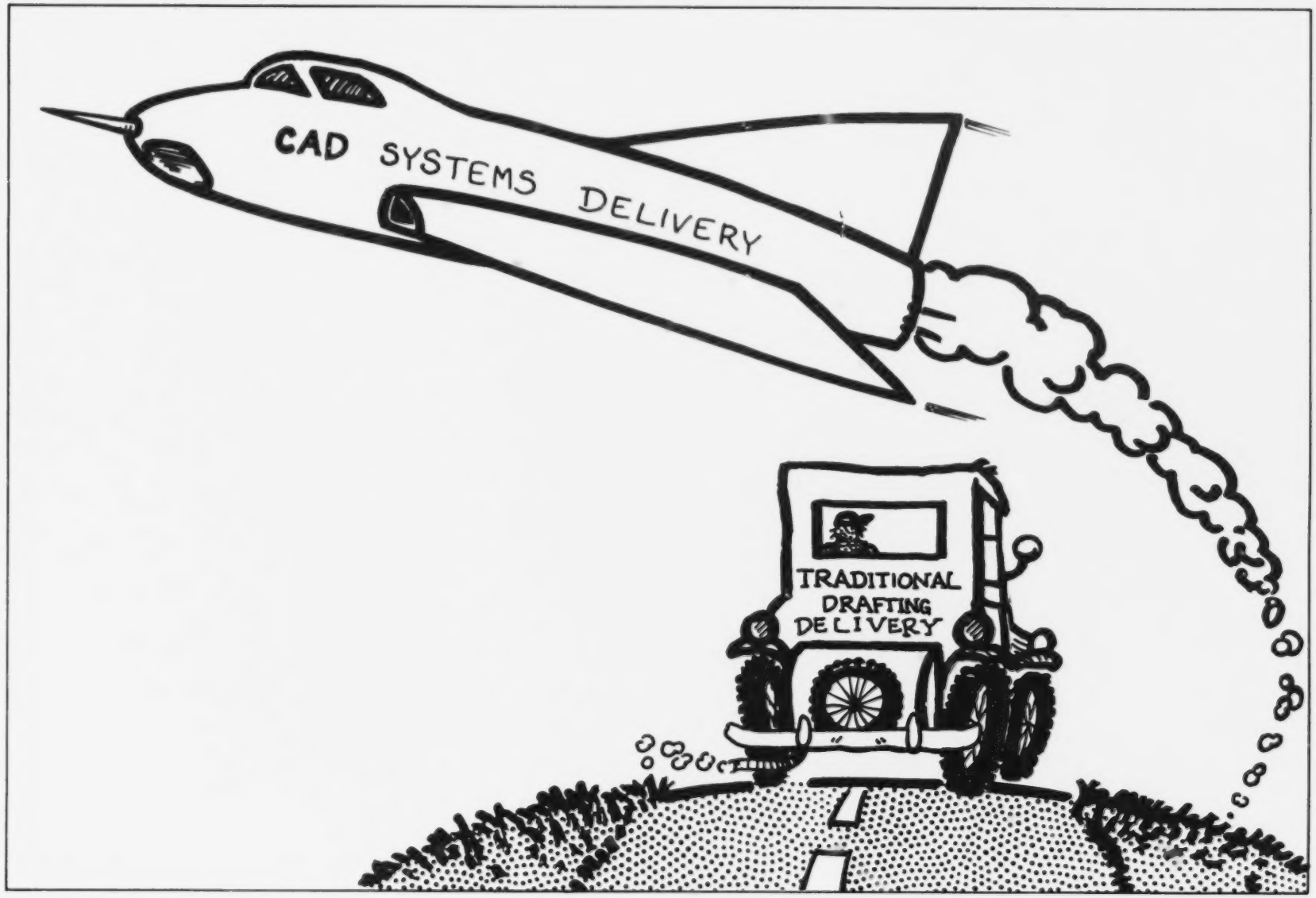
ANSWERS TO EVALUATION ITEMS:

1. T
2. F
3. F
4. T
5. T
6. T
7. F
8. F
9. T
10. T
11. c
12. b
13. b
14. a
15. d
16. c
17. c
18. d

# Drafting ... Changes in Drawing Production



# Speed -- An Advantage of CAD



LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I : UNDERSTANDING CAD

SCOPE OF UNIT:

Upon completion of this unit, the student will be oriented to the computer aided drafting environment. The first lesson will outline the differences between manual (traditional) and computer drafting and the second lesson will discuss the care of hardware and software.

INFORMATION TOPIC: X OR DEMONSTRATION:

HARDWARE AND SOFTWARE CARE
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Match components of CAD systems to correct descriptions.
2. Identify principles of hardware care.
3. Identify principles of software care.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. TM 1: The Hardware
2. TM 2: Hardware Care Rules
3. TM 3: Disk Care Rules
4. HO 1: Tips for Protecting Diskettes
5. Instructor - prepared handout regarding current copyright laws

INFORMATIONAL ASSIGNMENT: (Student)

The student should be instructed to read the manufacturer's information packed with many floppy diskettes and any information from the system (hardware) manufacturer that may apply to this topic.

REFERENCES: (Instructor's Additional Information)

See bibliography.

Bertoline, Gary R. Fundamentals of CAD. Albany, New York: Delmar Publishers Inc., 1985.

Luehrmann, Arthur and Peckham, Arthur. Computer Literacy: A Hands-On Approach. New York: McGraw-Hill Book Co., 1983.

INTRODUCTION:

Many people are afraid of computers. There is even a word for it: "technophobia." Aside from the anxiety that is usually experienced when faced with learning to operate advanced technology devices, much of this fear seems to come from a feeling of worry about destroying expensive equipment or software.

Computers are not as delicate as you may think. It actually is rather difficult to hurt them. In this lesson we will go over the "do's" and "don'ts" of computer care. Follow these guidelines and hardware or software will rarely be lost or damaged.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I: UNDERSTANDING CAD

OUTLINE: (Key Points)

I. Parts of a Computer System

A. Hardware - in general, hardware is anything that can be touched or handled. (TM I)

1. Monitor (often called a CRT) (II-1)

a. CRT - acronym for Cathode Ray Tube

b. The monitor is the television-like device that displays information from the computer's CPU.

2. CPU

a. Central Processing Unit (II-2)

b. The "brain" of the computer - the part that does the actual processing of information supplied to the computer system

3. Disk drives

a. Mechanical devices that store programs and data on diskettes

b. Stores information in a nonvolatile form

(1) By comparison, the computer's memory stores information in a volatile form.

(2) If the computer's power is shut off, all information in memory is lost.

c. Disk drives are sized (or classified) as 3 1/2", 5 1/4", 8", or fixed (hard) disk drives.

4. Keyboard

a. Resembles a typewriter

b. Most data is entered through the keyboard.

5. Other hardware

   a. Plotter

      (1) Plots the finished drawing on paper

      (2) May be electrostatic or pen type

      (3) Finished drawing is usually drawn to scale

   b. Graphics tablet

      (1) Used to input CAD data into the computer

      (2) Often the main input device for a CAD system

B. Software

1. If a turntable, speakers, etc., can be considered the "hardware" of a stereo system, then records and tapes can be considered the "software."

2. Diskettes are the "records" that a computer uses.

3. The diskettes and manuals themselves are not software. (II-3)

   a. Diskettes and manuals contain (or store) software.

   b. Software exists only in an electronic (or magnetic) form. It cannot be handled or touched.

4. Diskettes store information that the computer reads into memory just as a stereo system reads music from a record.

5. Unlike a stereo system and records, the computer can also put information onto the diskettes.

   a. Diskettes contain "programs" or software, and the computer can update or modify this data at any time.

   b. By contrast, records contain information (music) supplied by the manufacturer which cannot be changed.

6. There are three types of computer programs.

   a. System programs

(1) Programs of this type are for use by the computer only.

(2) They are usually "invisible" to the person operating the computer.

(3) System programs help the computer to do its most basic jobs such as starting up and using a disk drive.

(4) Example is a disk operating system (DOS) program.

b. Utility programs

(1) Utility programs help a person to do a computer-oriented task more efficiently.

(2) Examples of utility programs would be a disk copying program or a computer language (such as FORTRAN or BASIC).

c. Application programs

(1) Application programs help a computer to do a people-oriented task.

(2) An example would be a word processing program.

(3) A CAD program is an application program.

II. Hardware Care (TM 2)

A. It is usually difficult to hurt a computer system, but damage can occur under certain circumstances.

1. Unplugging the computer while the power switch is on

2. Subjecting the computer to physical shocks or abuse

a. Dropping the computer

b. Spilling liquids into the system

c. Airborne smoke and dust

3. Static electricity from carpets and clothing

4. Removing protective covers to explore inside the system. Few, if any, user-serviceable parts are inside.

B. A computer cannot be permanently or seriously damaged by the user keying in incorrect information or by pressing the wrong key.

C. At worst the computer can "lock up."

1. Data may be lost.

2. Computer may have to be restarted (booted).

3. No damage to the hardware can result.

III. Software Care (Diskette Protection) (TM 3, HO 1)

A. Do not touch the parts of the diskette that show through the black plastic protective case.

1. The disk drive reads and writes information through this opening.

2. Body oil and residue contained in a fingerprint can keep the computer from reading or writing information to the diskette.

B. Do not force the diskette into the drive. If it will not go in easily, something is wrong.

1. Check to see if a diskette is already in the drive.

2. Be sure the disk drive door is not closed.

C. Beware of magnetism

1. Screwdrivers and other tools

2. Motors and speakers

3. Magnets

4. Paper clips kept in a magnetic holder

D. Handle diskettes like glass.

1. If you drop a diskette when it is not in the sleeve it will probably be destroyed.

a. The diskette surface will pick up dust and dirt from the floor.

b. Placing a dirty diskette into a disk drive can damage the disk drive heads.

2. Do not bend or fold a diskette.

3. Do not use paper clips or staples on the diskette.

E. Keep diskettes protected from extreme temperatures.

1. Do not expose diskettes to freezing temperatures.

2. Do not leave diskettes in a hot car or in direct sunlight.

F. If the diskette contains important information or programs, copy it. (II-5)

1. The only way to be certain that your information will not be lost is to have more than one disk that contains the same information.

2. Three copies for most information

a. Working copy

b. Back-up copy

c. Archival copy

3. Five copies for critical information - two extra back-up copies

G. Copyright restrictions - it is against the law to copy disks protected by copyright (the CAD program disks)

NOTE TO INSTRUCTOR: Current copyright laws should be reviewed and appropriate information made available to students to protect them, the instructor, and the school.

IV. Summary and Conclusion

A. Parts of a computer system

B. Hardware care

C. Software care

A bit of care and common sense is all that is needed to protect equipment and software. Protect your critical data with back-ups and observe sensible precautions when moving or working with the computer. If you follow these simple rules you will encounter few if any problems.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I: UNDERSTANDING CAD

INTERACTION ITEMS: (Review Items)

1. What is the monitor used for?

2. What does CPU stand for?

3. Is a diskette hardware or software?

4. What type of program is a CAD program?

5. Why should diskettes be backed up?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. A field trip to a working CAD facility is recommended. (Alternative: A classroom visit from one or more CAD equipment sales representatives.)

2. Have students disassemble a damaged or worn out diskette and examine the inside.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I: UNDERSTANDING CAD

EVALUATION ITEMS:

For each of the following, write "T" if the statement is true or "F" if it is false.

1._____ You can damage a computer by pressing the wrong key.

2._____ Static electricity can damage a computer.

3._____ Software is comparable to the turntable of a stereo system.

4._____ You should store unused disks in a freezer to keep them fresh.

5._____ CPU stands for Central Processing Unit.

6._____ Three kinds of programs are application, utility, and assistance.

7._____ Computers are easily damaged.

8._____ If you must mail a disk, you should staple it securely to a piece of stiff cardboard.

9._____ Never bend a disk.

10._____ "Software" is another name for a computer program.

11. Match the terms listed below to the correct definitions.

1. Hardware
2. Software
3. Diskette
4. CPU
5. CRT
6. Disk Drive
7. Back-up

A._____ The programs that enable a computer to do a job

B._____ The "brain" of the computer

C._____ A second or third copy of software or data

D._____ An object that can be used to store programs or data for later use

E._____ Any part of a computer system that can be touched or handled

F._____ Display screen

G._____ The unit that writes information onto diskettes

LESSON PLAN: 2

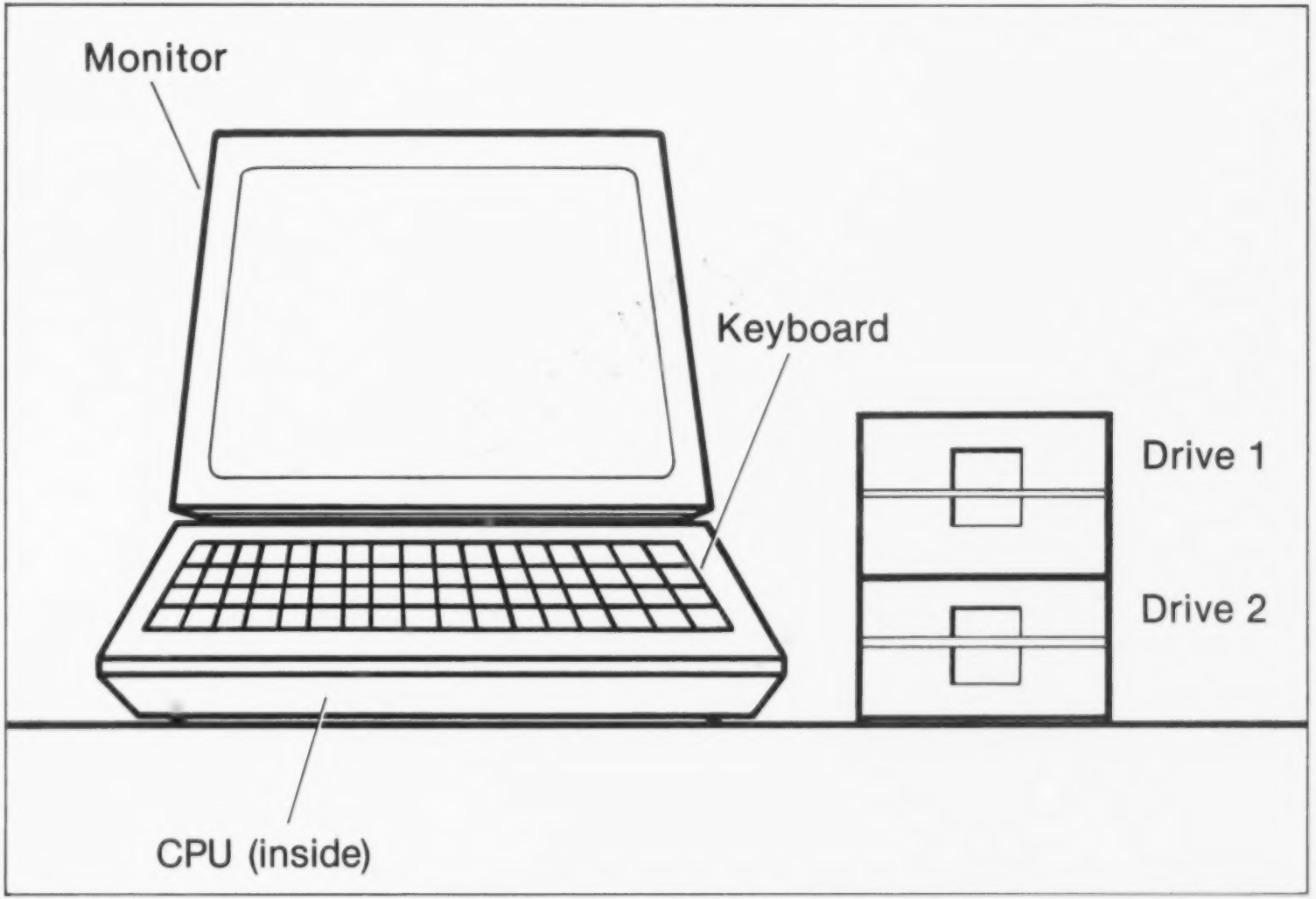
COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT I: UNDERSTANDING CAD

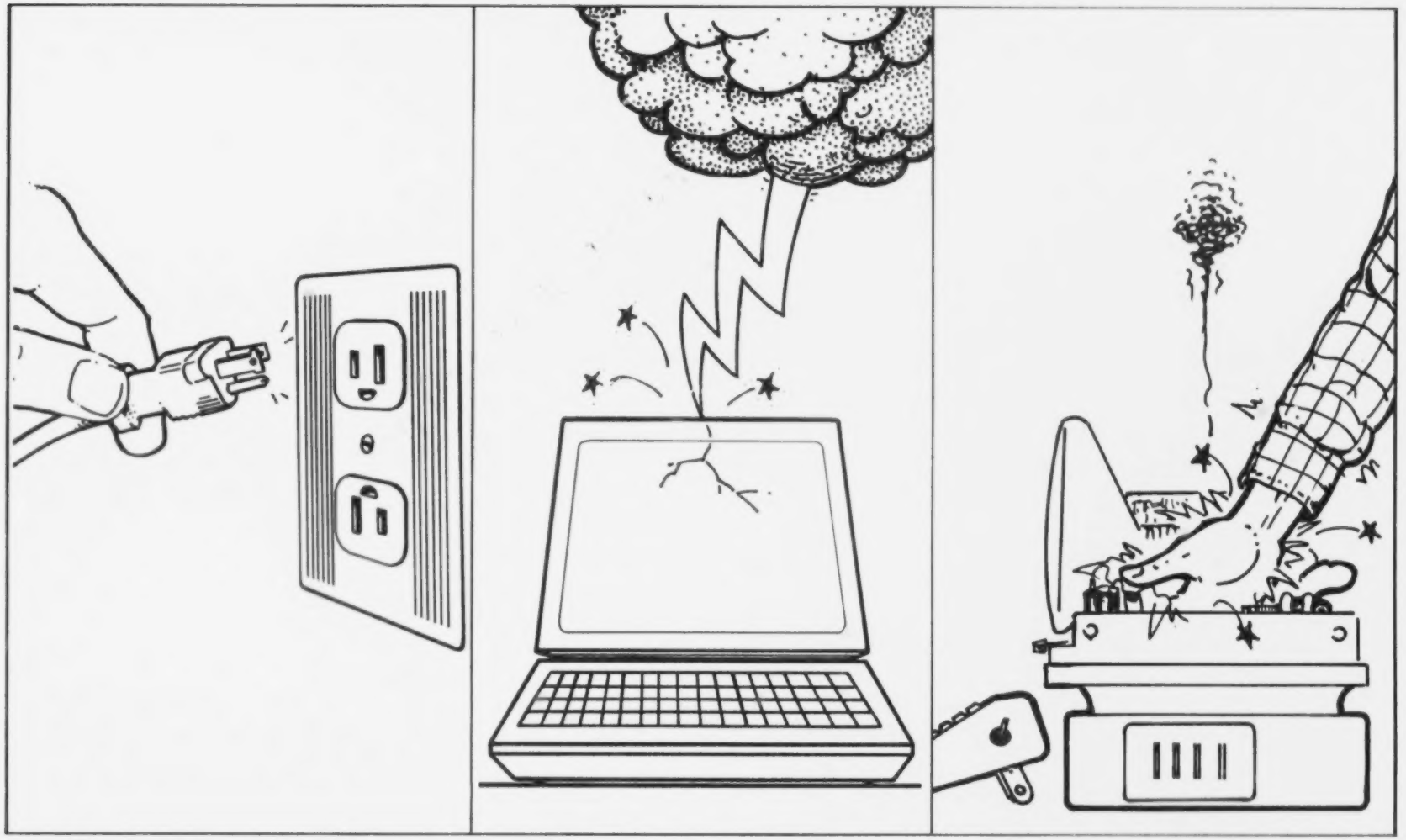
ANSWERS TO EVALUATION ITEMS:

1. F
2. T
3. F
4. F
5. T
6. F
7. F
8. F
9. T
10. T
11. A. 2
    B. 4
    C. 7
    D. 3
    E. 1
    F. 5
    G. 6

# The Hardware



# Hardware Care Rules

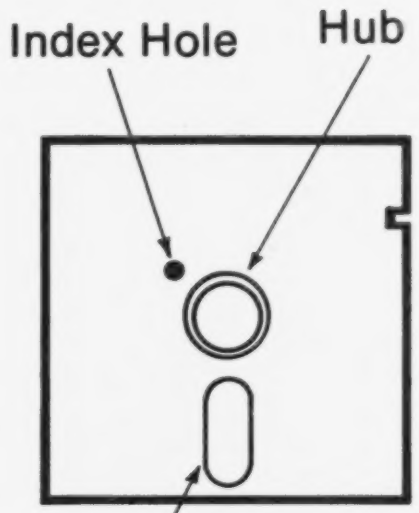


Do not unplug the computer while the power switch is still on.

Do not expose the computer to static electricity.

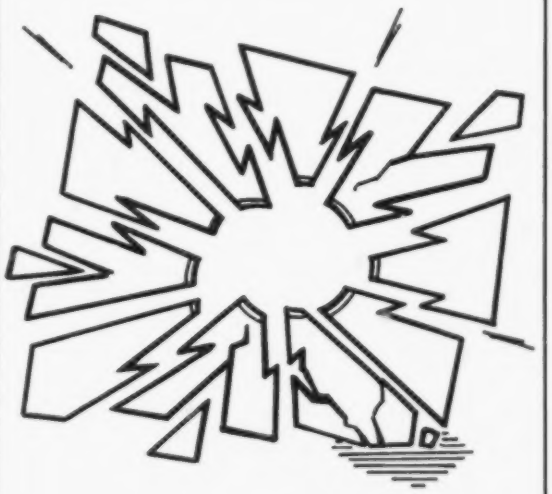
Do not remove the protective cover to explore inside the system.

# Disk Care Rules




Do not touch the exposed areas of the disk.

Beware of magnetism.



Handle the disk like glass -- be careful not to drop it.

1. DON'T TOUCH THE OPENINGS (The exposed plastic slits or dots that show through the black plastic case). They're vulnerable to fingerprints, dust, ashes, sneezes and maybe even dirty looks. The best way to keep things from touching them is to keep the disks in the protective envelope any time they are not actually in the drive being used.

2. DON'T JAM THE DISKS INTO THE DISK DRIVES. Ease them gently into the drive so they don't bend, get scratched, or otherwise become damaged.

3. BEWARE OF MAGNETISM. The disk's "memory" comes from a critical arrangement of tiny magnetic particles on the disk's surface. Exposing the disk to any kind of magnetic field, (which is present around television sets, electric motors, coils in loudspeakers and many other things) can disturb the arrangement of these particles - your disk will be damaged.

4. HANDLE DISKS LIKE GLASS. Don't bend them, sit on them, drop things on them, use them to prop up table legs, etc.

5. KEEP DISKS PROTECTED FROM TEMPERATURE EXTREMES. Store disks at a temperature between 50 and 125 degrees Fahrenheit. Intense heat and cold can cause loss of memory or weakened sensitivity. Generally, if the room is comfortable for you it is safe for your disks.

6. IF THE DISK CONTAINS IMPORTANT INFORMATION, COPY IT. Let's face it, the information on a disk is usually worth a whole lot more than the price of the disk both in terms of input time and the value of the information itself. So by all means, if the data is valuable (and all data is valuable), make a copy of the disk and store it someplace safe like a deposit box or a fireproof vault.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT II : THE COMPONENTS OF A CAD SYSTEM

SCOPE OF UNIT:

The unit will introduce and define the components of a computer aided drafting system. It also covers many of the terms needed to further study computer aided drafting.

INFORMATION TOPIC: X OR DEMONSTRATION:

PARTS OF A CAD SYSTEM
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. List three types of input devices.
2. List three types of output devices.
3. List three types of processors.
4. Match types of input devices with the correct definitions.
5. Match types of output devices with the correct definitions.
6. Identify functions of the processing section.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. TM 1: Primary Input Devices
2. TM 2: Other Input Devices
3. TM 3: Computer Arrangement

INFORMATIONAL ASSIGNMENT: (Student)

Readings from classroom texts at instructor's discretion; readings from any introduction to data processing texts as applicable

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

Heller, Dorothy and Bower, June. Computer Confidence: A Woman's Guide. San Lorenzo, CA: Acropolis, 1983.

INTRODUCTION:

The computer environment is filled with catch phrases and special words. Abbreviations, acronyms, and technical terms abound. Each piece of equipment and every operation has special language unique to it. This unit will define many of the terms and explain most of the equipment that one encounters in the study of computer aided drafting.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT II : THE COMPONENTS OF A CAD SYSTEM

OUTLINE: (Key Points)

I. CAD Equipment Components (II-1)

A. Input devices

1. Keyboard
2. Disk drives
3. Monitor
4. Digitizing device
   a. Graphics tablet
   b. Mouse
   c. Others

B. Output devices

1. Monitor
2. Plotter
3. Printer
4. Others

C. Processing section

1. The computer type is defined by the processor type.
   a. Microcomputer
      (1) Microprocessor-based
      (2) Small; low cost; limited capacity
   b. Minicomputer
      (1) Usually less than $150,000 value
      (2) Often has multiuser capabilities

c. Mainframe computer

(1) The largest type of computer

(2) Usually the CAD operator is one of many users on the same system.

(3) Computer may be shared with other unrelated departments such as accounting or personnel.

d. Others

(1) Super computer

(2) Experimental computers

2. Processing section is also called the CPU.

(Note: The following information should be presented as specific to the particular equipment that is used in your institution's program of instruction.)

II. Input Devices Used With CAD (TM 1, TM 2) (II-2)

A. Keyboard - a typewriter-like device that allows the user to enter alphanumeric instructions to the CPU

B. Graphics (digitizing) tablet - used with a stylus (such as an electronic pen) to enter data points

C. Joystick

1. An input device that directly controls the position of the cursor as displayed on the monitor

2. Often used as an input device for computer games

D. Light pen

1. A photosensitive device that can be used to enter data directly into the CPU by touching points on the surface of the CRT

2. Often replaces the graphics tablet

E. Trackball (or thumb wheels)

1. The position of the cursor is controlled by rolling (turning) a spherical device on an x-y axis.

2. Similar in function to a joystick

F. Puck (or mouse)

1. A hand-operated device that sends positional data to the CPU

2. The position of the device is automatically converted to an x-y digitized point.

3. A mouse can be compared to an upside-down trackball.

III. Output Devices Used With CAD (II-3)

A. Monitor (or CRT)

1. Displays output information on a television-like screen

2. Three types

a. Raster scan

(1) Information is displayed as 525 horizontal lines that are continuously refreshed, based on information received from the CPU.

(2) Most common and most inexpensive type of display

(3) Disadvantages

(a) May not display perfectly round circles.

(b) Angular lines display as a series of small "steps."

b. Vector refresh

(1) Information is displayed as scanned lines, drawn in an x-y manner.

(2) Angular lines display as straight lines and circles are quite round.

(3) Disadvantages:

(a) High cost

(b) May not work with many micro-based CAD systems

c. DVST (Direct View Storage Tube)

(1) Lines are displayed similarly to a vector refresh display; however, a DVST tube has a memory of its own.

(2) Computer does not have to update data unless a change is made in the display.

(3) Disadvantages

(a) High cost

(b) DVST requires specialized output circuitry; will not work with many micro-based systems

3. Many monitors can double as input devices when used with a light pen.

B. Plotter

1. A plotter will mechanically produce a hard copy of a digitized drawing with a pen.

2. Four types

a. Drum type

(1) The paper is fastened to a rotating drum.

(2) The pen moves on the x axis and the rotation of the drum produces motion on the y axis.

b. Microgrip type

(1) The paper is gripped in a pincer arrangement and moved forward and backward to produce y axis motion.

(2) The pen moves right and left to produce x axis motion.

c. Flatbed type

(1) The paper is placed on a flat surface and held in place by a static charge.

(2) The pen is mounted on a bar that allows the pen to move on both the x and y axes.

d. Electrostatic plotter

(1) Actually a large copy machine

(2) Similar in function to an office copier but the copy produced is based on information supplied by the computer

C. Printer

1. A printer is faster and, in many cases, more convenient than a plotter for producing a hard copy of a drawing.

2. Output from a printer does not approach that of a plotter in quality.

3. The drawing produced by a printer is usually not to scale.

4. A hard copy from a printer is usually used only for reference.

IV. Functions of the Processing Section (TM3) (II-4)

A. Memory

1. Allows storage of data

2. RAM - Random Access Memory

a. Contains information to be used during execution of program or data created by execution of program

b. Also used to store the program itself

c. If power is lost, all information in RAM is permanently lost.

d. Information in RAM must be stored on permanent storage devices to be used again later.

(1) Diskettes

(2) Hard disk

(3) Tape

(4) Others

e. Information in RAM is being continuously changed and updated by the computer or by command of the operator.

f. The CAD program is usually stored in RAM.

3. ROM - Read Only Memory

a. Contains the start-up operating system and other information used to run the system

b. Always available - not destroyed or changed by a power loss

c. Cannot be changed by the system or operator

B. Control section

1. The "control tower" of the computer

2. Directs all other parts and operations of the computer system

C. Arithmetic/logic section

1. Performs all math and logic functions of the computer

2. A/L section is under the direction of the control section.

V. Summary and Conclusion

A. CAD equipment components

B. Input devices used with CAD

C. Output devices used with CAD

D. Functions of the processing section

Like any other technical field, CAD has its own jargon. Fortunately much of this jargon overlaps the data processing field in general. A CAD operator does not need to be a "computerese" linguistics expert, but a general familiarity with computer terms is helpful and has been explained in this lesson.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT II : THE COMPONENTS OF A CAD SYSTEM

INTERACTION ITEMS: (Review Items)

1. What are the three areas of a computer system?

2. Name some input devices.

3. How do you get information back out of the computer?

4. What are the three parts of the processing section?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. The students could complete a vocabulary and/or spelling exercise based on computer terms.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT II : THE COMPONENTS OF A CAD SYSTEM

EVALUATION ITEMS:

1. List the three types of computer input devices.

   a.

   b.

   c.

2. List three types of output devices.

   a.

   b.

   c.

3. List the three types of computers in order from most expensive to least expensive.

   a.

   b.

   c.

Match the following terms to the correct definitions.

| | | | |
|---|---|---|---|
| _____ 4. | Keyboard | A. | The "brain" of a computer |
| _____ 5. | Graphics (digitizing) tablet | B. | Read Only Memory |
| _____ 6. | Plotter | C. | Typewriter-like device used to enter data into the computer system |
| _____ 7. | Puck | D. | Video game-like controller for direct positioning of the cursor |
| _____ 8. | RAM | | |
| _____ 9. | Monitor | E. | Hard copy device that uses a pen |
| _____10. | Joystick | | |

_____11. Printer

_____12. ROM

_____13. CPU

_____14. Light pen

F. Hand-operated device that sends positional data to the CPU

G. Random Access Memory

H. Output device that displays data on a screen

I. Output device often used to produce a reference hard copy

J. Photosensitive device used to enter data by touching the surface of the CRT

K. A flat surface, used with a stylus or pen to input data points

Fill a T in the blank if the statement is true and an F if the statement is false.

_____15. Even if power is lost, all information in Random Access Memory is still saved.

_____16. Information in Random Access Memory must be stored on diskettes to be used again later.

_____17. Read Only Memory is always available and is not destroyed or changed by a power loss.

_____18. The control section of the computer is under the direction of the arithmetic/logic section.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT II : THE COMPONENTS OF A CAD SYSTEM

ANSWERS TO EVALUATION ITEMS:

1. a. Keyboard
   b. Disk drives
   c. Monitor

2. a. Monitor
   b. Plotter
   c. Printer

3. a. Mainframe computer
   b. Minicomputer
   c. Microcomputer

4. C

5. K

6. E

7. F

8. G

9. H

10. D

11. I

12. B

13. A

14. J

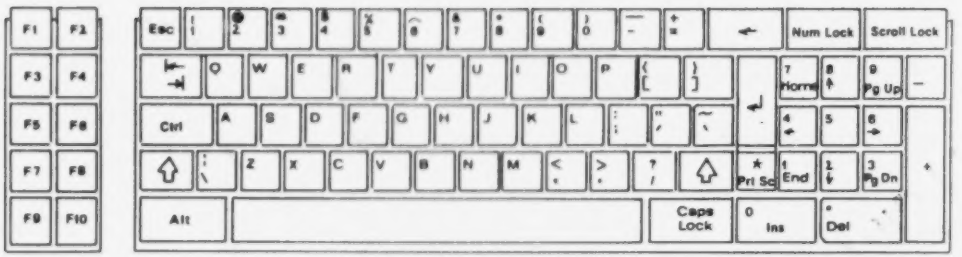
15. F

16. T

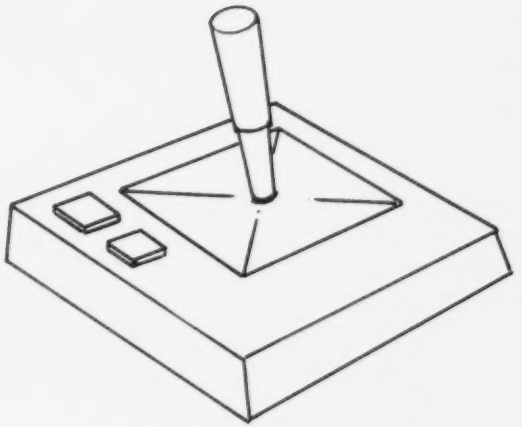
17. T

18. F

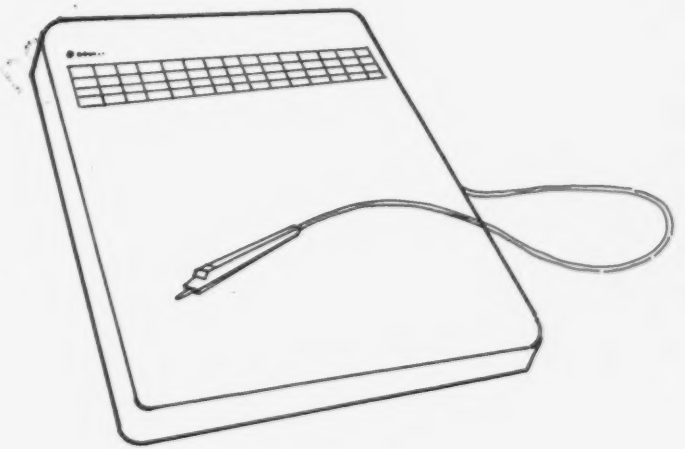
# Primary Input Devices




Keyboard



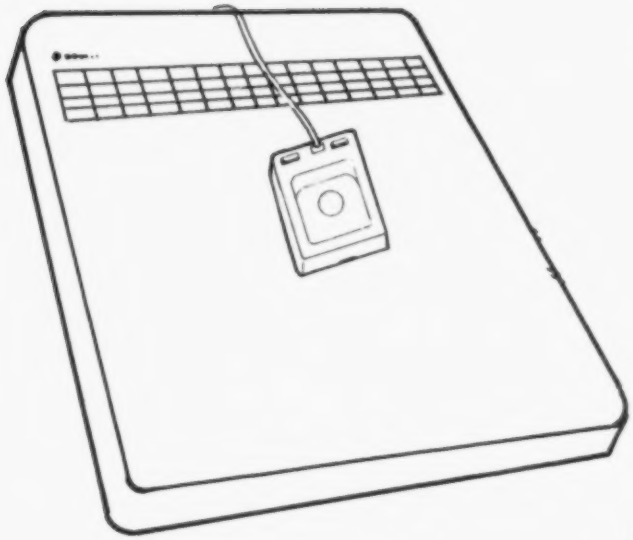
Joystick



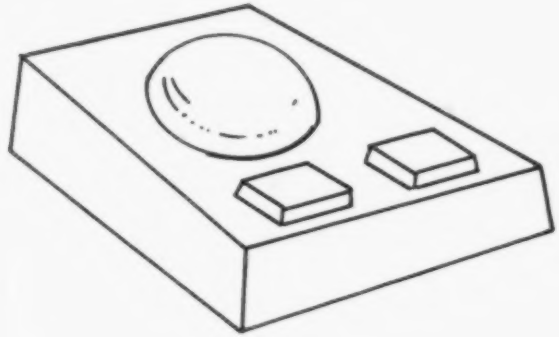
Graphics (Digitized) Tablet

# Other Input Devices

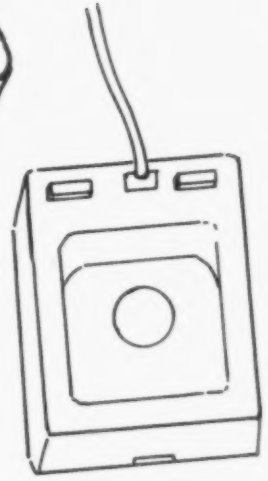
Light Pen



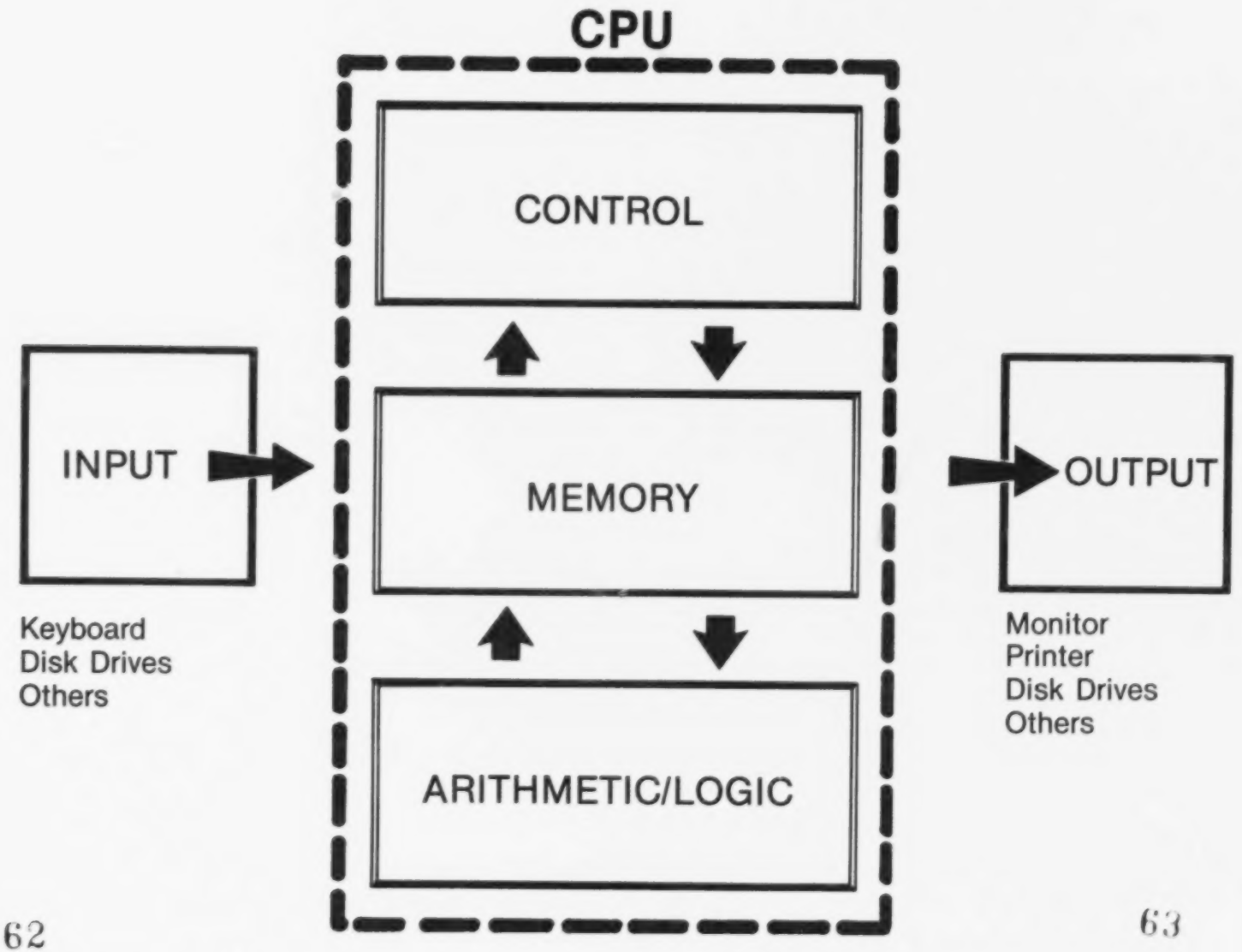
Puck
(or mouse)



Trackball



# Computer Arrangement



LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT III: INITIALIZING A CAD SYSTEM

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to log on and access a system/program.

INFORMATION TOPIC: OR DEMONSTRATION: X

LOGGING ON A CAD SYSTEM
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Log on to the classroom CAD system according to the steps of procedures.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. Classroom CAD System
2. System-specific instructional materials supplied by instructor

INFORMATIONAL ASSIGNMENT: (Student)

The student should read any "machine specific" information pertaining to the log on procedure (and log off procedure if required).

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

Documentation for classroom system

INTRODUCTION:

Before a drawing can be produced on a CAD system, the program must be loaded into memory and operating. This procedure is called logging on. During the log on process, the operator identifies him/herself (assuming the operator has permission or clearance to access the CAD system) and supplies the additional start-up data as needed by the computer.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT III : INITIALIZING A CAD SYSTEM

STEPS OF PROCEDURES:

(NOTE: This log on procedure outline reflects the steps required to log on to a MATC or Computervision CAD system. This outline should be modified to show the steps required for the system being used in your class.)

I. Power-Up Sequence

A. Turn on all peripheral devices

1. Plotters

2. Printers

3. Other equipment

B. Insert disks

1. Program disk in drive one

2. Initialized data disk in drive two

C. Power-up CPU

II. Log On System

(NOTE: Depending on the system used, you may have to refer to Unit XII, Lesson 1: Logging Off a CAD System)

A. Screen Message:

MATC CAD
Computer Aided Drafting
Copyright 1985
Enter Today's Date (DD/MM/YY):

1. Enter correct date

2. Press <CR> (Return)

B. Screen Message:

```
Licensed Representative
Licensed to
Serial #0000
```

1. Press <Cntl> and <R>.

2. Enter a number from 1 to 9 (e.g., 3).

3. Enter <J> if using a joystick.

4. Type CADDS and press <CR>.

C. Screen Message: (II-1)

```
>3 CADDS
OLDPART=0 NEWPART=N REPLY=
```

1. Press <O> to recall previously stored drawing for revision or further work.

2. Press <N> to create a new drawing.

D. Screen Message: (II-2)

```
Part Name:
```

1. Part name should not exceed 7 characters. It must always begin with an alpha character.

2. Do not include any dashes, spaces, or special characters.

3. Screen display:

```
#
```

4. Begin your drawing.

III. Summary and Conclusion

A. Power-up sequence



B. Log on system (II-3)

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT III : INITIALIZING A CAD SYSTEM

INTERACTION ITEMS: (Review Items)

1. What is the difference between an "0" and an "N" drawing?

2. Describe a part name.

3. How does "power-up" differ from "log on?"

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. Students should practice logging on to the classroom CAD system.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT III : INITIALIZING A CAD SYSTEM

EVALUATION ITEMS:

INSTRUCTOR NOTE: This evaluation should be modified to show the steps required for the system being used in the classroom.

| DID THE STUDENT: | | YES | NO |
|---|---|---|---|
| I. | Complete power-up sequence. | | |
| | A. Turn on all peripheral devices. | | |
| | B. Insert disks. | | |
| | C. Power-up CPU. | | |
| II. | Log on the CAD system. | | |
| | A. Enter correct date. | | |
| | B. Press <CNTL> and <R> keys. | | |
| | C. Enter a number from 1 to 9. (Enter <J> if using a joystick.) | | |
| | D. Type CADDS and press <CR> key. | | |
| | E. Press <0> to recall a previously stored drawing. | | |
| | F. Press <N> to create a new drawing. | | |
| | G. Type in part name. | | |
| | H. Begin the drawing. | | |

The student has satisfactorily completed the procedure "LOGGING ON A CAD SYSTEM" according to the steps of procedures.

_____
Instructor's Signature
(Verifying Satisfactory Completion)

_____
Date

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

SCOPE OF UNIT:

Upon completion of this unit the student will be familiar with the wide range of input devices used in computer aided drafting. Included are the keyboard, graphics tablet, and other devices.

INFORMATION TOPIC: X OR DEMONSTRATION:

THE KEYBOARD
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Identify differences and similarities between a typewriter keyboard and a computer keyboard.
2. Identify functions of various keys on the computer keyboard.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. TM 1: The Keyboard
2. TM 2: Cursor Movement Keys

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

In an increasingly technological age, certain basic occupational skills are becoming as important as reading skills. For the CAD operator, along with skills such as drafting and math skills, the ability to type is essential. This unit will discuss the differences between a typewriter keyboard and a computer (or CAD) keyboard.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

OUTLINE: (Key Points)

I. The Typewriter Keyboard

A. QWERTY standard keyboard (II-1)

1. Named so because of the first six keys in upper left row of letters.

2. The QWERTY keyboard is designed to limit typing speed.

a. When the first typewriters were developed, a fast typist could jam keys at the platen.

b. To correct this problem, commonly used keys were moved out of the home row to allow the typewriter time to recover between keystrokes.

3. Mechanical limitations are no longer a problem.

a. Computer or electronic keyboards are much faster than the QWERTY.

b. However, the QWERTY keyboard is the most common type. Most people learn on it.

B. Other keyboards

1. Dvorak keyboard

a. The most commonly used keys are in the "home position".

b. Speeds of 180 words per minute not uncommon on Dvorak keyboard.

c. Recent research indicates the Dvorak keyboard may not be a big improvement

(1) Cost of retaining

(2) Time required for retaining

(3) Incompatability with existing equipment

(4) Other considerations

2. ASCII keyboard

a. Similar in many ways to QWERTY keyboard

b. Commonly found on data entry devices

II. The Computer Keyboard

A. Usually similar to or related to QWERTY keyboard

B. Often includes features of ASCII keyboard

C. Operational functions

1. Shift key (II-2)

a. Must be held down while striking a second key to insert the shifted character

b. Must always be used to type the secondary markings on double marked keys

c. If caps lock key is not active, shift key must be used to type upper case letters.

2. Caps lock key

a. Similar but not identical to a typewriter shift lock key

b. Affects only the alpha characters

(1) Produces all upper-case letters when active

(2) Does not affect any of the double-marked keys

c. Often reverses the action of the shift key

(1) When caps lock is active, pressing the shift key will often produce lower case letters.

(2) Does not affect double marked keys; must press shift key to obtain secondary character

(3) Typical of IBM systems

3. Tab key

   a. Programmable key

   b. Actual function is strictly defined by the active software

   c. Usually causes the cursor to jump a predetermined number of spaces

4. Return key (also called the enter key) (II-3)

   a. Used to signal the computer at the end of an entry

   b. Any information that the operator has entered is sent to CPU by pressing the return key.

   c. Similar in function to a carriage return on a typewriter

   d. For computer operations the return key is more accurately referred to as the enter key.

      (1) Used to enter information into the computer

      (2) Signals that human data entry is completed and that it is time for computer processing

(Note: The following information will need to be modified by the instructor to reflect the functions of the classroom CAD system. This listing reflects the application of an IBM-based system.)

D. Keys unique to the computer (II-4)

1. Some keys found on a computer are not found on a typewriter.

   a. There is no need for programmable keys on a typewriter.

   b. All typewriter keys are intended to produce marks on paper, whereas many computer keys simply control the system in one of several ways.

2. Control key

   a. Used with another key to produce an alternate function

b. For the most part, the control key has no function unless defined by software.

c. Some key combinations are semidefined.

(1) <Ctrl>-S is often used to halt the output to the screen until another key is pressed.

(2) <Ctrl>-H is the same as a backspace.

(3) <Ctrl>-P is often connected with printer control.

(4) <Ctrl>-Z is often used to mark the end of a disk file.

3. Escape key

a. Often used to abort the current function or operation

b. May be thought of as a "panic button"

c. Escape key has no function unless it is defined by software.

4. Backspace key

a. Used to erase the last character typed

b. When pressed, the cursor will move one space to the left and erase the character in that position.

c. Sometimes called a delete key

5. Alternate key

a. Could be defined as an alternate control key

b. Used with other keys to produce alternate functions

c. Has no function unless defined by software

6. Number lock key (II-5)

a. Affects only numeric key pad area

b. Deactivates cursor movement keys on some keyboards

c. Similar in function to caps lock key for the alpha section of the keyboard

7. Cursor movement keys

a. Allows user to move cursor up, down, left, or right

b. Cursor movement keys often double as numeric keypad keys

8. Other keys

a. Scroll lock key

(1) Programmable key

(2) Primarily on IBM systems

b. Insert/delete keys

(1) Programmable keys

(2) Often used to allow insertion of text during line editing functions

III. Summary and Conclusion

A. The typewriter keyboard

B. The computer keyboard

Keyboard layout will vary widely from CAD system to CAD system. The only similarity will be in the alpha typewriter section (even in the typewriter section, the shifted punctuation characters will vary from system to system). The CAD operator must learn the details of the system that he/she will be using. The more familiar the operator becomes with the appropriate keyboard, the smoother all CAD operations will become.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

INTERACTION ITEMS: (Review Items)

1. Where does the term "QWERTY" come from?

2. What does a shift key on a typewriter do?

3. What is a "carriage return" on a typewriter?

4. What are some of the keys on the computer that are not on a typewriter?

5. If the caps lock is for the letters, what do you think the num lock is for?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. Have the students write research projects on the development of the typewriter keyboard.

2. Have the students try typing on other keyboard types. The Dvorak is among the most interesting.

3. Have the students design their own typewriter keyboard placing the most commonly used keys in a better position.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

EVALUATION ITEMS:

For each of the following, write "T" if the statement is true or "F" if it is false.

_____ 1. A typewriter keyboard is identical to a computer keyboard.

_____ 2. The QWERTY keyboard is the only keyboard you will find on a computer.

_____ 3. The shift key affects only the letters.

_____ 4. The caps lock key affects only the letters.

_____ 5. When the number lock key is activated, you may not use the cursor movement keys.

_____ 6. The return key is sometimes called the escape key.

_____ 7. The backspace key is sometimes called the delete key.

_____ 8. All CAD systems have a similar keyboard layout.

_____ 9. There are some keys found on a computer that are not found on a typewriter.

_____10. The tab, alternate, and control keys are programmable keys.

LESSON PLAN: 1

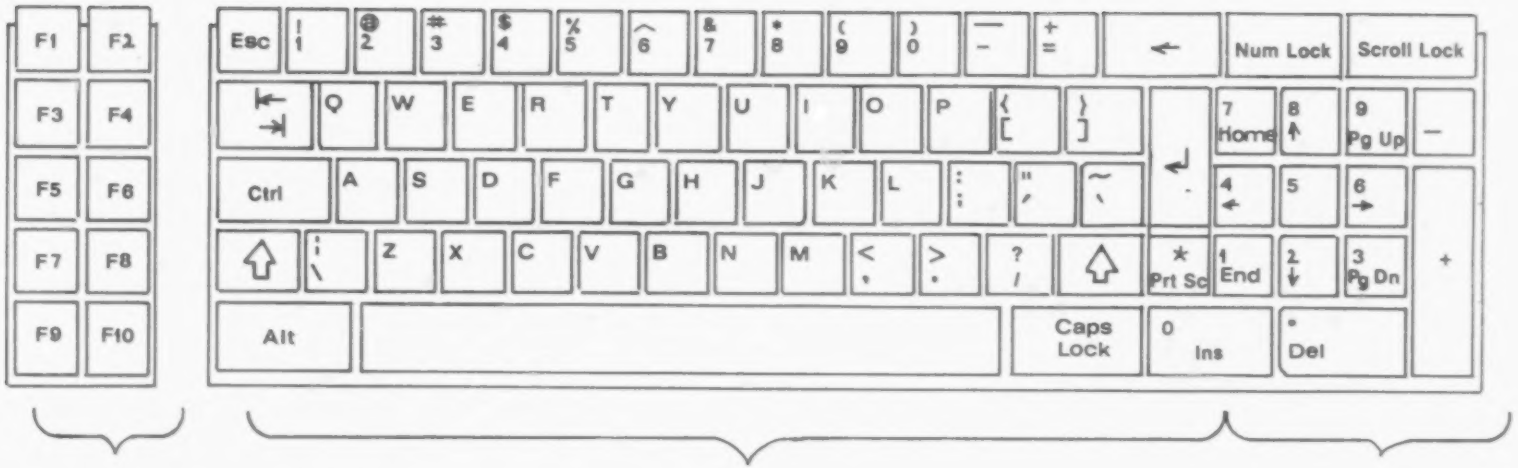
COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

ANSWERS TO EVALUATION ITEMS:

1. F
2. F
3. F
4. T
5. T
6. F
7. T
8. F
9. T
10. T

# The Keyboard

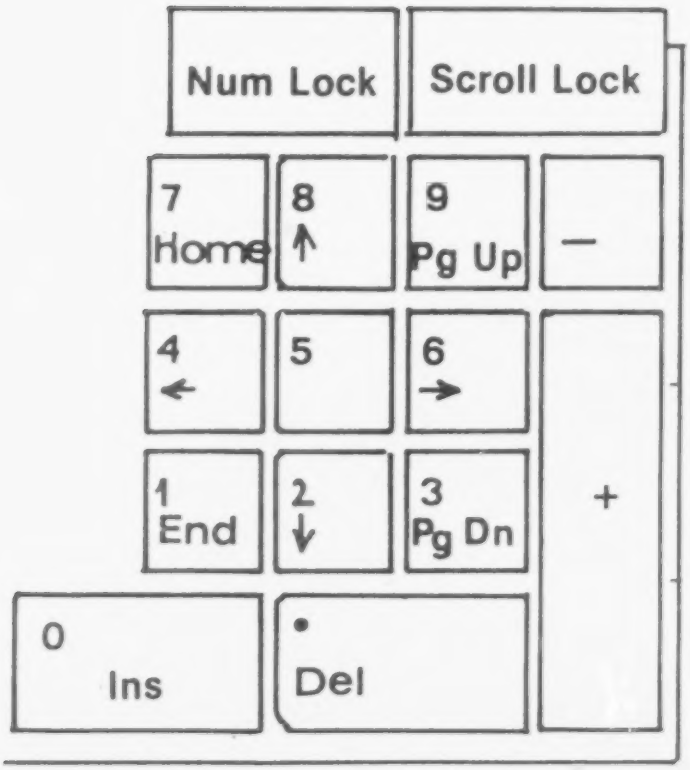



Function Keys

Typewriter Keyboard

Numeric Keyboard

# Cursor Movement Keys



LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

SCOPE OF UNIT:

Upon completion of this unit, the student will be familiar with the wide range of input devices used in computer aided drafting. Included are the keyboard, graphics tablet, and other devices.

INFORMATION TOPIC: X OR DEMONSTRATION:

AUXILIARY INPUT DEVICES
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Match the following terms to the correct definitions:
   a. Graphics (digitizing) tablet
   b. Light pen
   c. Joystick
   d. Trackball
   e. Puck (mouse)
   f. Function keyboard

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. H0 1: Auxiliary Input Devices

INFORMATIONAL ASSIGNMENT: (Student)

The student should read the manufacturer's information pertaining to the special equipment used on the classroom CAD system.

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

See Unit IV, Lesson 1.

Ralston, Anthony and Reilly, Edwin D., Jr. Encyclopedia of Computer Science and Engineering. 2nd ed. New York: Van Nostrand Reinhold Co., Inc., 1982.

INTRODUCTION:

The keyboard is not always the best way to get CAD data into a system. Linear or point data can be entered most easily with an auxiliary device such as a digitizing tablet or a puck. This lesson will examine the various input devices that may be used in a CAD system and define their uses. Pros and cons of the devices are not considered because the actual mechanics of using the various devices are dependent on the application within a specific CAD system. Only a mechanical description will be presented.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

OUTLINE: (Key Points)

I. Graphics (Digitizing) Tablet (HO 1)

A. Used with an electronic stylus to input data points into the system

1. A stylus is an electronic pen connected to the computer by a wire.

2. The stylus usually contains a coil or other sensing device that sends positional data back to the computer.

B. Data is sent to the computer, which translates that data into an x-y location.

C. A menu is usually located at the top of the digitizing area. (II-1)

1. Allows quick, simple selection of commands

2. Decreases the need for the operator to switch back and forth between the keyboard and the auxiliary device

II. Light Pen (TM 2) (HO 1)

A. Photosensitive device

B. Data is entered by pressing the pen point directly onto the display screen at the desired location.

C. Data is translated into x-y locations by the software.

III. Joysticks (Paddles) (HO 1) (II-2)

A. A joystick consists of two variable resistance devices (potentiometers) mounted in a case at 90 degree angles to each other.

B. Pushing the stick up and down (+y, -y) changes the resistance, which is translated into a position along the axis.

C. Pushing the stick right and left (+x, -x) changes the resistance, which is translated into a position along the x axis.

D. Paddles are an alternate form of the joystick.

1. Paddles are knobs attached directly to the resistance devices.

2. Each knob is rotated clockwise or counter-clockwise to select an x-y value.

IV. Trackball (Thumbwheels) (HO 1)

A. A trackball is a spherical device "trapped" in a box. The sphere can be rotated in any direction to select an x-y value.

B. Thumbwheels are an alternate version of the trackball.

1. Thumbwheels are simple wheel-like controls. One wheel controls the x position and the other controls the y position.

2. Any position on the screen can be selected by the proper combination of the wheel settings.

3. Thumbwheels are actually more closely related to paddles.

V. Puck (Mouse)

A. Hand-operated device

B. The actual position is "sensed" by the computer and translated by the system into x-y data.

C. A puck is often used with a graphics tablet-like device.

D. An alternate version is called a mouse.

1. A mouse is described as an upside-down trackball.

2. The mouse is pushed across a flat surface, causing the ball to rotate.

3. Operationally, the mouse is similar to a puck.

VI. Function Keyboard (II-3)

A. A function keyboard can be compared to a push button menu.

B. For example, pressing the line button places the system in the line mode.

1. Data entered following selection of the line mode is interpreted by the system as relating to the construction of point-to-point lines.

2. Another input device is needed to enter the actual locational data.

VII. Summary and Conclusion

A. Graphics (digitizing) tablet

B. Light pen

C. Joysticks (paddles)

D. Trackball (thumbwheels)

E. Puck (mouse)

F. Function keyboard

This list of input devices is by no means all-inclusive. New methods of inputting data into the computer are being developed every day. It is possible that in the near future all of these devices will be made obsolete by voice entry of data. In the meantime, however, these devices remain the most common methods of CAD data input.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

INTERACTION ITEMS: (Review Items)

1. What is a menu?

2. What are other uses for a joystick in addition to CAD input?

3. What can a function keyboard be compared to?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. Hold an input device design contest trying to design the optimum input device.

   (Example: A graphics tablet with built-in function keys)

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

EVALUATION ITEMS:

Match the following terms to the correct definitions listed below.

_____ 1. Graphics (digitizing) tablet

_____ 2. Joystick

_____ 3. Puck (or mouse)

_____ 4. Trackball

_____ 5. Function keyboard

_____ 6. Light pen

a. Also called a game controller

b. A sphere, trapped in a box; rolled to input data

c. A flat, table-like device used with a stylus to input data

d. Used directly on the monitor

e. A push button menu

f. A hand-operated device sometimes used with a tablet

LESSON PLAN: 2

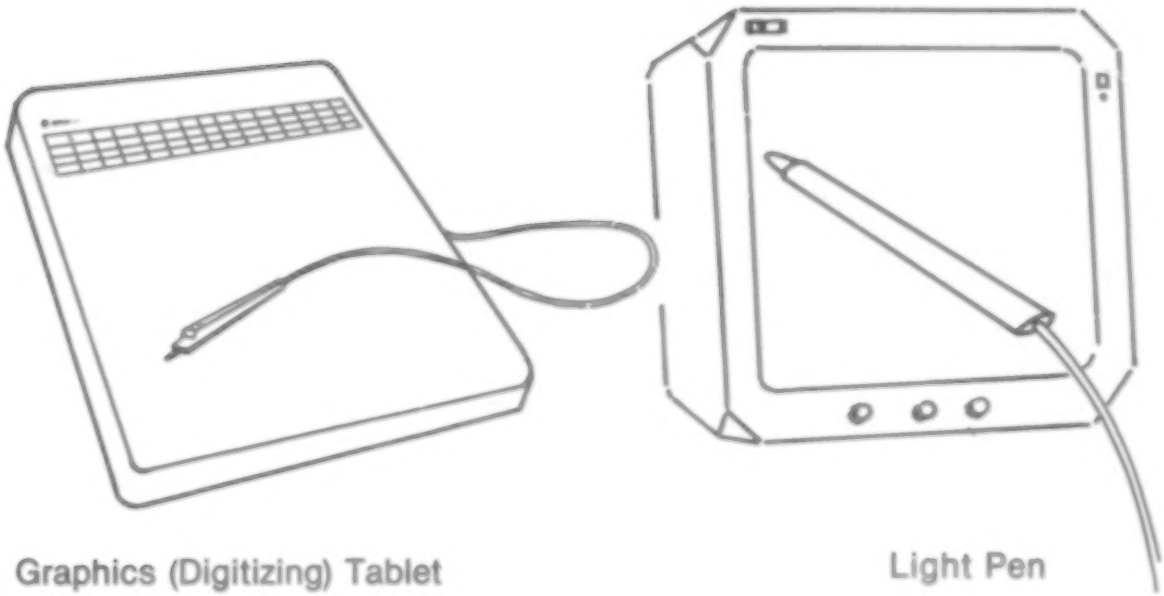
COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IV : USING INPUT DEVICES

ANSWERS TO EVALUATION ITEMS:

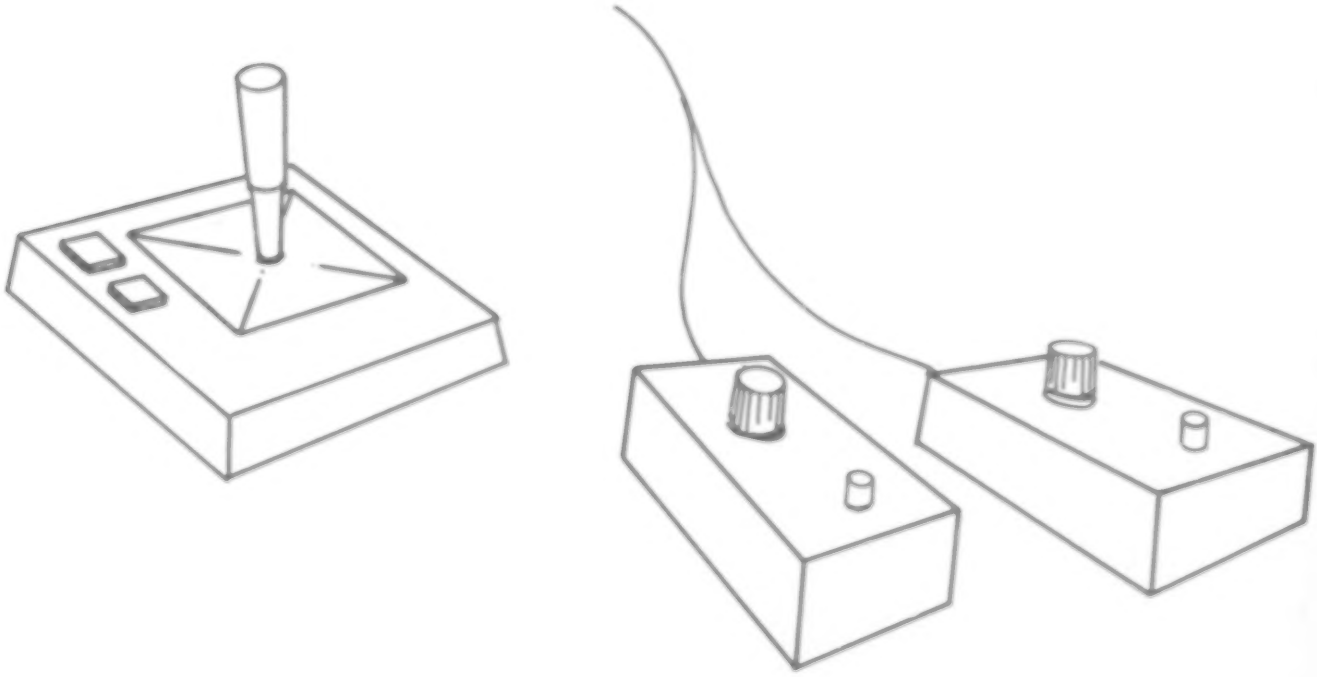
1. c
2. a
3. f
4. b
5. e
6. d

# Auxiliary Input Devices



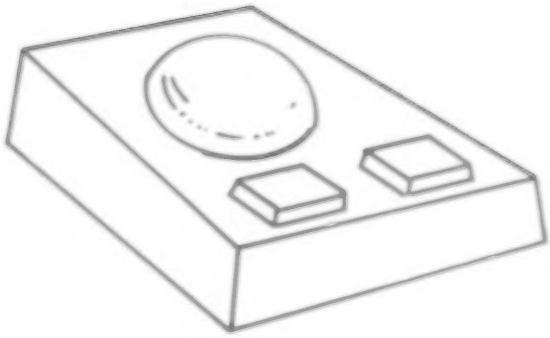
Graphics (Digitizing) Tablet

Light Pen

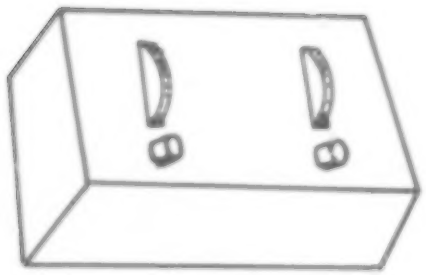


Joystick

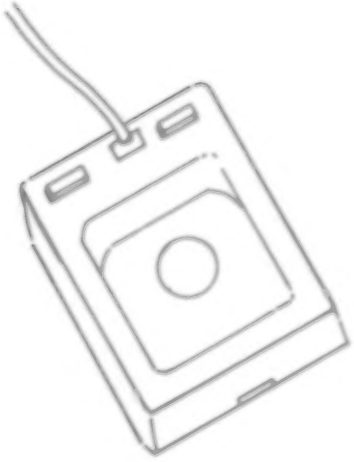
Paddles



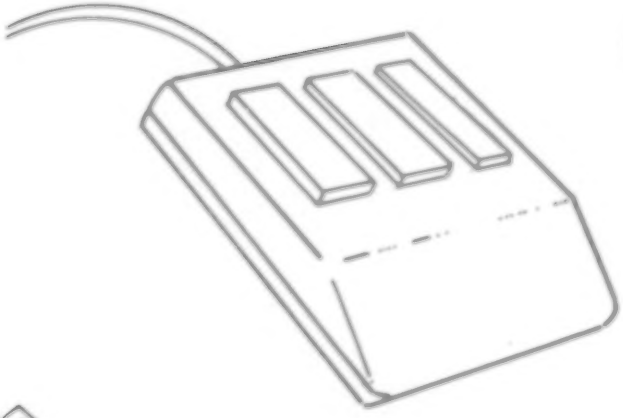
Trackball



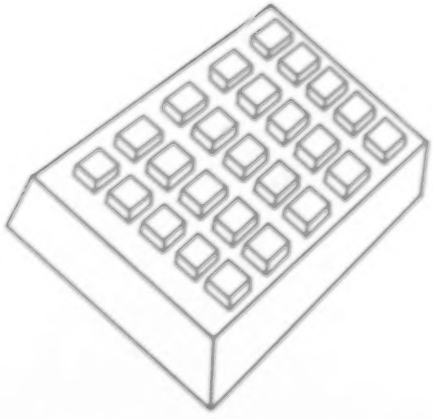
Thumbwheels



Puck



Mouse



Function Keyboard

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT V: SETTING DRAWING PARAMETERS

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to select the parameters needed to begin a CAD drawing. Included are selection of paper size, selection of scale, and the establishment of the internal drawing parameters on the classroom CAD system.

INFORMATION TOPIC: OR DEMONSTRATION: X

SETTING PAGE SIZE
(Lesson Title)

LESSON OBJECTIVE - THE STUDENT WILL BE ABLE TO:

1. Select an appropriate paper size for a specified CAD drawing according to the steps of procedure.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. TM 1: Paper Sizes

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

When a drafter begins a traditional drafting project, the first step is to select the correct size paper for the drawing. If the initial choice is wrong and the drawing requires more space, often the drawing will have to be redone. Correct choice of the space required to contain a drawing is important. In this unit we will examine the material selection process for a CAD drawing.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT V: SETTING DRAWING PARAMETERS

STEPS OF PROCEDURE:

I. Paper Sizes (TM 1)

A. Over the years, the drafting industry has established guidelines for drawing sizes.

B. These guidelines can vary widely from employer to employer.

C. In general, the paper sizes are as follows: (II-1)

1. "A" size - approximately 8-1/2 x 11 inches

2. "B" size - approximately 11 x 17 inches

3. "C" size - approximately 17 x 22 inches

4. "D" size - approximately 22 x 34 inches

5. "E" size - approximately 34 x 44 inches

6. Roll sizes 44" x any length

II. Paper Size Selection in CAD

A. Selection of paper sizes is sometimes limited by the size of the output devices available to the system. (II-2)

1. A system may be limited to a "B" or "C" size plotter.

2. The system may have other larger or smaller output devices attached.

B. Paper sizes may be automatically determined by the system.

1. Once a drawing scale is determined, the system may place the drawing on the optimum sized piece of paper.

2. System may suggest possible paper sizes based on the scale of the finished drawing.

III. Procedure for Paper Size Selection

(Note: This portion of the lesson plan should be modified to reflect the needs of the classroom CAD equipment. Refer to system documentation for necessary details on system being used for instruction. The following procedure reflects the steps necessary to set paper size on an MDX System Six. Your system may differ.)

A. The command ">view setup.2d" is used to access the setup file.

B. The information in this file is changed by moving the cursor to the desired line with the arrow keys and making the necessary changes.

C. Each line in the file is defined as follows:

1. Name of dimensioning setup file
2. Reserved value
3. Paper size
4. Font style
5. Font size
6. RESERVED, must be TEMPORARY
7. Default template, usually TEMPORARY
8. Cursor color
9. Precision value
10. Dimensioning mode letter
11. Menu
12. Background layer
13. Background layer color

D. Any remaining lines are paired background layers and colors. As many of these layers as desired may be entered into this file for automatic loading into the drawing.

1. Font sizes and styles are discussed in Unit V, Lesson 2.
2. Layers are discussed in Unit VII, lesson 1.

E. Move the cursor to line three of the file (paper size) and make any necessary changes.

F. Make any other necessary changes.

G. When all changes have been made, press the <escape> key.

H. The file will be saved as modified and will be used to set the parameters for the next work session.

IV. Summary and Conclusion

A. Paper sizes

B. Paper size selection in CAD

C. Procedure for paper size selection

Once the paper size is established, the drafter is ready to draw. Most systems will have default values for many of the other required parameters that can be changed as required. The next lesson will examine the modification of some of the other drawing parameters.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT V: SETTING DRAWING PARAMETERS

INTERACTION ITEMS: (Review Items)

1. How big is "A" size paper? (or "B" size, or "C" size, etc.)

2. Why must you tell the system the paper size first? Why can't you wait until the drawing is printed or plotted?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. Have the students practice selecting paper size on the classroom CAD system.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT V: SETTING DRAWING PARAMETERS

EVALUATION ITEMS:

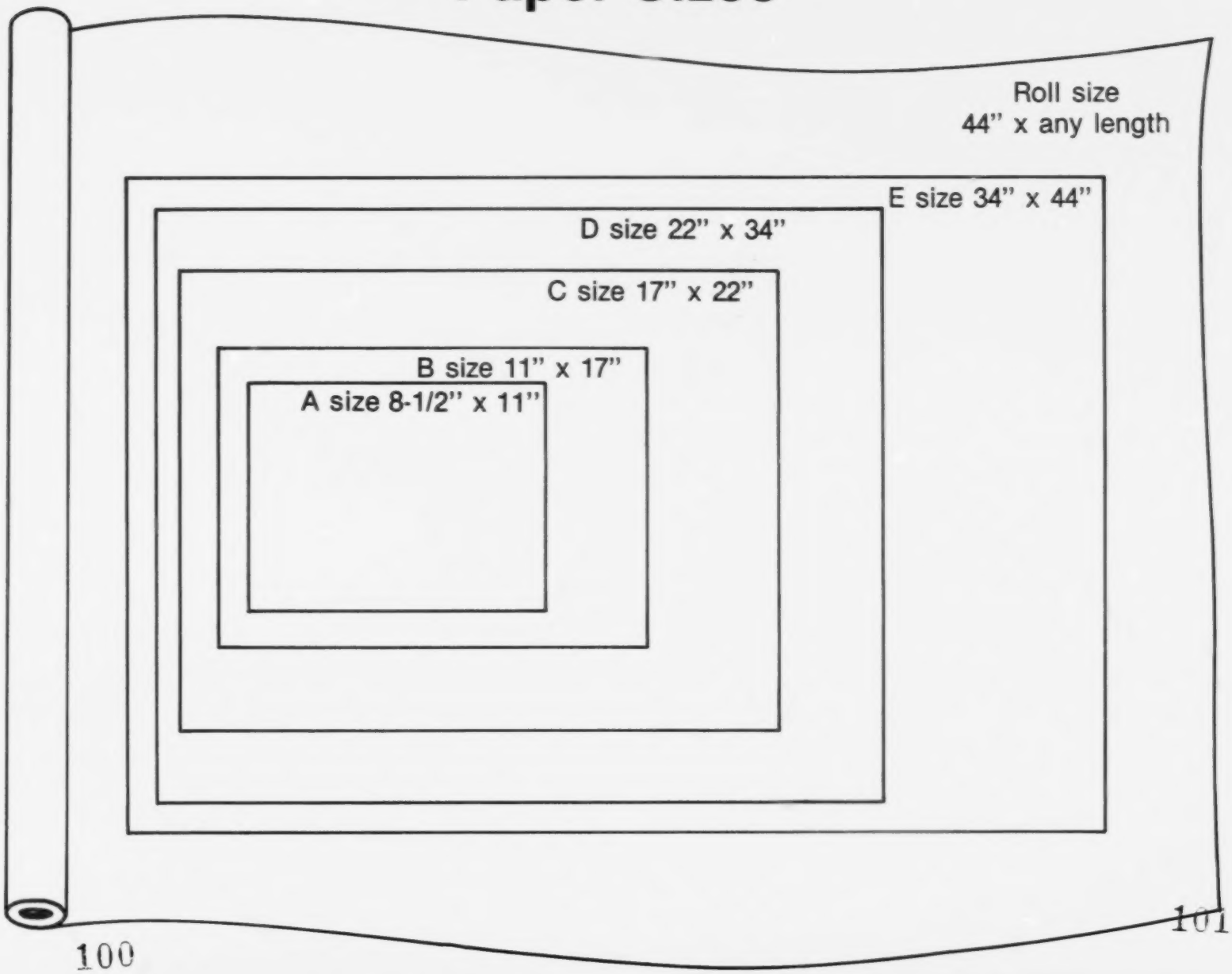
| DID THE STUDENT: | YES | NO |
|---|---|---|
| I. Select Paper Size. | | |
| A. Use appropriate command to access set up file. | | |
| B. Change paper size. | | |
| C. Press escape key. | | |
| D. Save file. | | |

The student has satisfactorily completed the procedure "SETTING PAGE SIZE" according to the steps of procedure.

Instructor's Signature
(Verifying Satisfactory Completion)

Date

# Paper Sizes






100

101

TM 1

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT V: SETTING DRAWING PARAMETERS

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to select the parameters needed to begin a CAD drawing. Included are selection of paper size, selection of scale, and the establishment of the internal drawing parameters on the classroom CAD system.

INFORMATION TOPIC: OR DEMONSTRATION: X

SELECTION OF SCALE, UNITS, AND FONT
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Select a scale for a given drawing according to the steps of procedure.
2. Select lettering style and font size for a given drawing according to the steps of procedure.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

INFORMATIONAL ASSIGNMENT: (Student)

The student could be assigned review materials on scales and scaling from traditional curriculum.

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

The size of the paper is not the only thing to consider when starting a new drawing. Often, in fact, the paper size selection is affected by the settings of other parameters. For example, the scale that is chosen may limit the paper sizes available. This unit will examine the selection of some of the other start-up drawing parameters.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT V: SETTING DRAWING PARAMETERS

STEPS OF PROCEDURE:

I. Scale in a CAD Drawing

A. All drawings in a CAD system are done at full scale. (II-1)

1. The actual scale of the finished hard copy is determined by the limits of the hard copy device.

2. Scale may also be affected by the selection of the paper size. (See Unit V, Lesson 1.)

B. Scale selection may automatically be performed by system.

1. System fits finished drawing to paper size selected.

2. Operator may choose to override; operator may then choose to print a certain drawing at a specified scale.

3. Other options or controls may be available on other systems.

II. Units of Measure (II-2)

A. Some CAD systems will allow the operator to define a basic unit of measurement.

B. Possible choices include feet and inches, inches, or millimeters.

C. Often, however, a CAD system will use an undefined unit and the operator will simply define that unit.

1. The unit may be defined while plotting.

2. The unit may be defined in the title block.

III. Procedure for Selecting a Scale

(Instructor Note: This portion of the lesson plan should be modified to reflect the needs of the classroom CAD equipment. Refer to system documentation for necessary details on system being used in your classroom. The

following procedure reflects the steps necessary to set paper size on an MDX System Six. Your system may differ.)

A. Scale control is accomplished with the worldscale command. (II-3)

1. The paper scale is defined as the distance between the sprocket holes at the border of the paper.

2. The distance between each mark is equal to one inch of drawing paper.

B. All dimensions in the drawing are generated based on the worldscale setting.

C. Selecting the worldscale command

1. Enter the worldscale command.

a. A worldscale of 1/2 would cause each inch on the drawing screen to equal two units on the plotted drawing.

b. A worldscale of 3/1 would cause three inches on the drawing screen to equal one unit on the plotted drawing.

c. A worldscale of 1/25.4 would cause each inch on the drawing screen to equal 25.4 millimeters on the plotted drawing (full scale metric).

d. A worldscale of 1/1 would be read as one inch equals one foot.

e. A worldscale of 0.25/1 would be read as 1/4 inch equals one foot.

2. Enter the paper scale, a slash, and the drawing scale.

IV. Procedure for Selecting the Lettering Style and Font Size (II-4)

A. The command ">view setup.2d" accesses the setup file.

B. The information in this file is changed by moving the cursor to the desired line with the arrow keys and making the necessary changes.

C. The lines in the file are defined as follows:

1. Name of dimensioning setup file
2. Reserved value

3. Paper size

4. Font style

5. Font size

6. RESERVED, must be TEMPORARY

7. Default template, usually TEMPORARY

8. Cursor color

9. Precision value

10. Dimensioning mode letter

11. Menu

12. Background layer

13. Background layer color

D. Any remaining lines are paired background layers and colors. As many of these layers as desired may be entered into this file for automatic loading into the drawing.

1. Paper size selection is discussed in Unit V, Lesson 1.

2. Layers are discussed in Unit VII, Lesson 1.

E. Move the cursor to lines four and five of the file to set lettering style and font size.

F. Make any other necessary changes (at operator's discretion).

G. When all changes have been made, press the escape key.

H. The file will be saved as modified and will be used to set the parameters for the next work session.

V. Summary and Conclusion

A. Scale in a CAD drawing

B. Units of measure

C. Selecting a scale

D. Selecting the lettering style and font size

Once all the parameters are set, the operator is ready to

begin drawing. After awhile the operator will acquire a feel for the parameter settings. Selection will not require much thought. At first, however, the operator must consider all settings carefully. Speed in selection will come after experience on the system is gained.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT V: SETTING DRAWING PARAMETERS

INTERACTION ITEMS: (Review Items)

1. What does "full scale" mean?

2. What are some units of measure that can be use with CAD?

3. What does it mean to select a scale?

4. What is a font?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. The student should practice setting the scale and selecting the lettering font on the classroom CAD system.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT V : SETTING DRAWING PARAMETERS

EVALUATION ITEMS:

| DID THE STUDENT: | YES | NO |
|---|---|---|
| I. Select a scale if required. | | |
| A. Enter the worldscale command. | | |
| B. Enter the paper scale, a slash, and the drawing scale. | | |
| II. Select lettering style and font size if required. | | |
| A. Enter the desired lettering style. | | |
| B. Enter the desired font size. | | |

The student has satisfactorily completed the procedure "SETTING DRAWING PARAMETERS" according to the steps of procedure.

_____

Instructor's Signature
(Verifying Satisfactory Completion)

_____

Date

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VI : STORING AND RETRIEVING DATA

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to save and retrieve documents on the classroom CAD system. The unit also will cover the process of formatting disks and define terms associated with disk formatting.

INFORMATION TOPIC: X OR DEMONSTRATION:

DATA STORAGE ON CAD
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. List four characteristics of a disk.
2. Define a computer file, explaining how it differs from a traditional file.
3. List two definitions of the term format.
4. Describe how a disk is formatted by the computer.
5. List the steps involved when a user formats a disk.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. TM 1: Disk Formatting

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

IBM User's Reference Manual published by IBM.

Worth, Don and Lechner, Pieter. Beneath Apple DOS. Chatsworth CA: Quality Software, 1981.

INTRODUCTION:

Computers store information, in the form of files, on disks. If a traditional file can be defined as a collection of organized, related data stored on paper, then a computer file can be defined as a collection of organized, related data stored on a disk.

However, before a computer can use a disk it must be prepared by the computer to receive these files. This process is called formatting.

This lesson will examine two areas: the format of a file diskette and the process of preparing these diskettes to receive files.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VI : STORING AND RETRIEVING DATA

OUTLINE: (Key Points)

I. Terms and Definitions

A. Characteristics of a disk (or diskette)

1. Record-shaped device contained in a square package (3 1/2", 5 1/4", 8").

2. Information can also be stored on a hard or fixed disk.

3. A disk is similar to a record except: (II-1)

a. Information on a record cannot be changed.

b. A record has only one continuous "track" (groove).

c. A record does not store its information magnetically.

4. Disk is coated with iron oxide, a magnetic sensitive material.

a. Disk surface is identical to cassette or video tape.

b. Disk could also be defined as a circular piece of magnetic tape.

5. Inside black plastic case is a liner.

a. Tiny holes in liner trap any dust that may get on disk surface.

b. Liner polishes disk surface as it spins in the case.

B. File (II-2)

1. A file is a collection of organized, related data.

a. A traditional file is kept on paper and stored in a file folder.

b. A computer file is stored on a magnetic disk.

2. The difference between a traditional file and a computer file is the efficiency of the retrieval process.

   a. Paper file is slow, space-consuming, and inefficient.

   b. Computer file is fast, small, and very efficient.

C. Format

1. First definition: process of preparing a disk to receive information or data.

   a. Performed by the computer upon command

   b. Formatting procedure may vary from system to system.

2. Second definition: physical arrangement of data on the surface of the disk.

   a. "Tracks" and "sectors" on surface of disk in magnetic form

   b. Comparable to pages in a paper file

II. How the Computer Formats the Disk (TM 1)

A. Before a disk can be used by the system, it must be formatted.

1. Formatting is the process of marking a disk magnetically so the computer can find information stored on the disk.

2. Precise format arrangement and procedure vary from system to system.

B. When a disk is formatted, it is divided into tracks.

1. Tracks are a series of concentric circular marks on the surface of the disk.

   a. Marks are magnetic.

   b. Marks are invisible.

   c. There are 30 to 150 tracks on a disk, depending on the system.

2. Tracks are numbered starting with track 0 on outside of disk.

a. Highest numbered track is nearest center of disk.

b. Tracks never intersect.

C. The tracks are further divided into sectors.

1. Sectors are pie-shaped subdivisions of tracks.

2. Disks are divided into 8 to 32 sectors.

3. Varies from system to system.

III. How the User Formats the Disk

(NOTE: This procedure reflects the steps needed to format a disk on an IBM-based CAD system. Other systems will vary. The outline should be modified by the instructor to reflect the procedure for formatting disks on the classroom CAD system.)

A. Obtain a disk.

1. New disk

2. Used disk - contains information no longer needed

a. Any information already on the disk is destroyed by formatting process.

b. A good way to recycle disks

B. Place the disk in the drive (usually drive B or 2) without forcing the disk into position.

C. Call up disk format routine.

1. Type "format b:" and press <RETURN>.

2. Some systems may use a different command.

D. When system has finished, remove the formatted disk and store it properly.

1. Do not remove disk while disk drive indicator light is on.

2. Repeat process as needed to format additional disks.

IV. Summary and Conclusion

A. Terms and definitions

B. How the computer formats the disk

C. How the user formats the disk

Once the disk is formatted, the actual CAD work can begin. The precise procedure will vary from system to system and from software package to software package. The operator should have several formatted disks available whenever the system is powered-up. That way, if a problem does occur (disk failure, power failure, etc.), much of the data is retained.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VI : STORING AND RETRIEVING DATA

INTERACTION ITEMS: (Review Items)

1. How is a record different from a diskette?
2. What is a file?
3. List the steps to formatting a disk.

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. Before being evaluated, students should practice formatting disks until they are comfortable with the process.
2. Assign papers or reports on alternative computer storage systems (i.e., CD ROM, Bubble memory, others).
3. Have students format a diskette on the classroom system. Instructor should supervise and approve the process.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VI : STORING AND RETRIEVING DATA

EVALUATION ITEMS:

1. List four characteristics of a disk.

   a.

   b.

   c.

   d.

2. Define a computer file, and explain how it differs from a traditional file.

3. List two definitions of the term format.

4. Explain how a disk is formatted by the computer.

5. List the steps involved when a user formats a disk.

   a.

   b.

   c.

   d.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VI : STORING AND RETRIEVING DATA

ANSWERS TO EVALUATION ITEMS:

1. a. Record-shaped device contained in a square package (8" or 5 1/4" per side).

   b. Disk is similar to a record except:

      1. Information on a record cannot be easily changed.

      2. Record has only one continuous track.

      3. Record does not store information magnetically.

   c. Disk is coated with iron oxide.

   d. Inside the black plastic case is a liner, which traps dust and keeps it off the disk's surface. The liner polishes the disk surface.

2. A file is a collection of organized, related data. A paper file is slow, space-consuming, and inefficient; computer file is fast, small, and efficient.

3. a. The process of preparing a disk to receive information or data.

   b. Physical arrangement of the data on the surface of the disk

4. When a disk is formatted, it is divided into invisible magnetic tracks. There are from 30 to 150 tracks on a disk. They are numbered beginning on the outside of the disk with zero.

   The tracks are further subdivided into sectors, which are pie-shaped subdivisions of tracks. Each disk is divided into 8 to 32 sectors.

5. a. Obtain a new or used disk.

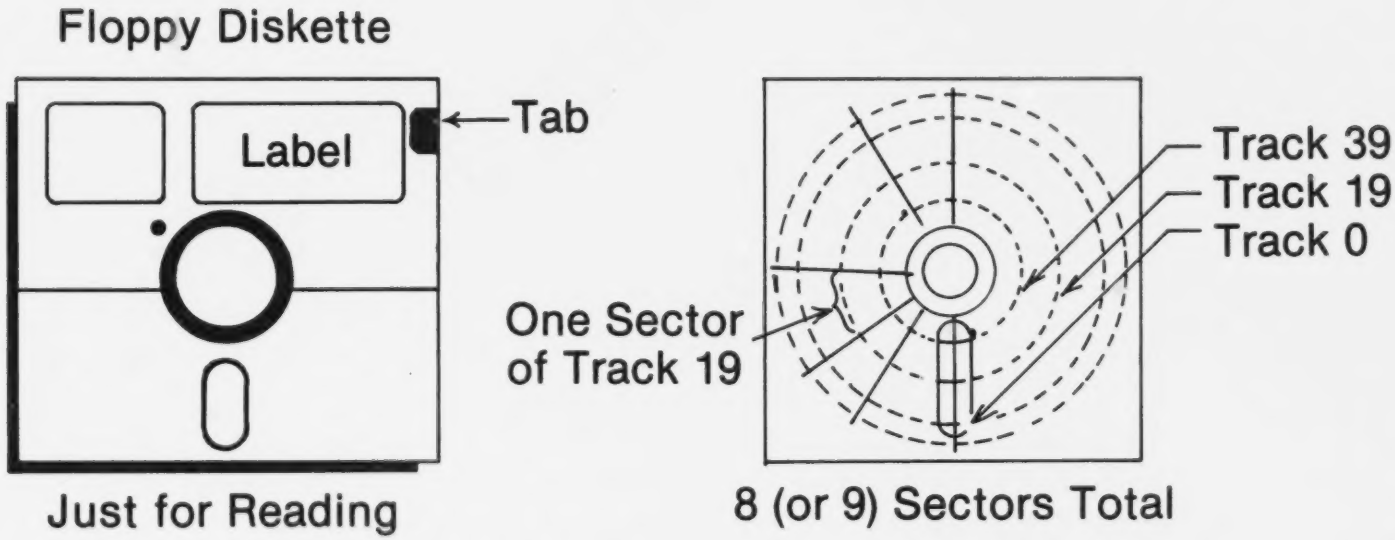
   b. Place the disk in the disk drive (usually drive B) without forcing it.

   c. Call the disk format routine by typing "format b:" and pressing <return> (command may be different on other systems).

d. Remove the formatted disk and store it properly. Do not remove the disk while disk drive indicator light is on.

# Disk Formatting





LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to create a CAD drawing using basic entities (e.g., lines, circles) and secondary entities (e.g., crosshatching) as components and to modify that drawing with the basic manipulation devices.

INFORMATION TOPIC: X OR DEMONSTRATION:

TERMS RELATED TO DRAWING WITH CAD
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Match terms relating to basic entity insertion with their definitions.
2. Define two terms relating to secondary entity insertion.
3. Define four terms relating to drawing manipulation.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See glossary.

See bibliography.

INTRODUCTION:

In this lesson we will review some basic drafting terminology and show how it is used in the context of CAD system. We also will learn some new terms that have meanings unique to CAD. This will prepare us to use the CAD system to create drawings in the next three lessons.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

OUTLINE: (Key Points)

I. Terms Related to Basic Entity Insertion

A. Entity

1. Single element of a graphic display

2. Line, circle, point, etc.

B. Origin

1. Single point marking the position of a basic entity in the system memory

2. Example: the origin of a circle is its center point.

C. Point

1. A nondimensional entity occupying a single x-y location

2. Displays as a small, vertical "X" or cross regardless of display scale

3. A point has no origin.

D. Line (II-1)

1. Technically a line segment

2. A line of "pixels" (digitized picture elements on the screen) connecting two specified locations in the two dimensional CAD environment

3. The x and y location of the point on each end of the line must be specified.

4. Origin of a line is its center (bisection point).

E. Circle

1. Specified by a radius or diameter and the location of the circle's center

2. Can also be specified by a construction through three points

3. Origin of a circle is its center.

F. Arc

1. Segment of a circle's circumference

2. May be specified in any manner by which a circle is defined (However, the start and the end of the arc must also be defined.)

3. Origin of an arc is its center point.

G. Fillet

1. An arc that intersects two lines, a line and an arc, or two arcs

2. Often used to "round-off" corners

3. Origin of a fillet is its center point.

H. Spline

1. An irregular "best curve" through a series of points

2. Origin of a spline is the second point digitized along its length. (II-2)

II. Terms Related to Secondary Entity Insertion

A. Crosshatching (II-3)

1. A pattern used to fill an area in a sectioned drawing

2. Often represents a particular building material

a. Different patterns are used for different materials.

b. These patterns are standard throughout the drafting industry.

B. Boundary

1. In CAD, a boundary is a line that delineates an area to be crosshatched.

2. In other words, the outline of the area to be filled

III. Terms Related to Drawing Manipulation

A. Mirroring

1. Process of creating a copy or moving an existing group of entities around two points (axis)

2. New image is reversed from right to left around a specified axis

B. Moving

1. Process of creating a copy or moving an existing group of entities

2. Optionally, existing entities may be copied to a new location leaving the existing entities intact.

C. Rotating

1. Process of creating a copy or moving an existing group of entities around a single center point

2. Differs from mirroring in that mirroring rotates around an axis (two points).

3. Optionally, existing entities may be copied to a new location leaving the existing entities intact.

D. Layers

1. Computer function similar to stacking many pieces of paper on top of one another

2. Allows different aspects of drawing to be shown on different layers (e.g., sectional views, notes and labels in various languages, dimensions in metric and English)

3. May be displayed or used as needed singly or in combination

4. Transparent

IV. Summary and Conclusion

A. Terms related to basic entity insertion

B. Terms related to secondary entity insertion

C. Terms related to drawing manipulation

Now that you are familiar with terms related to drawing with the CAD system we will use this knowledge to do operations on the classroom CAD system.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

INTERACTION ITEMS: (Review Items)

1. What is the definition of a line?
2. How would you draw a spline in traditional drafting?
3. When is crosshatching usually used?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. Student could identify CAD entities on drawings from traditional portion of program.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

EVALUATION ITEMS:

Match the following terms to the correct definitions.

_____ 1. Arc

_____ 2. Circle

_____ 3. Entity

_____ 4. Fillet

_____ 5. Line

_____ 6. Origin

_____ 7. Point

_____ 8. Spline

a. An arc that intersects two lines, a line and an arc, or two arcs; often used to round off corners

b. Irregular "best curve" through series of points

c. Single element of a graphic display

d. Nondimensional entity occupying a single x-y location

e. Specified by radius or diameter and location of its center; also, by a construction through three points

f. Segment of a circle's circumference

g. Technically a line segment, it is a series of pixels connecting two specified locations in the two-dimensional CAD environment

h. Single point marking an entity's position in the system's memory

Define the following terms:

9. Crosshatching

10. Mirroring

11. Moving

12. Rotating

13. Layers

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

ANSWERS TO EVALUATION ITEMS:

1. f
2. e
3. c
4. a
5. g
6. h
7. d
8. b
9. Pattern used to fill an area in a sectioned drawing
10. Process of creating a copy or moving an existing group of entities around two points (axis)
11. Process of creating a copy or moving an existing group of entities
12. Process of creating a copy of moving an existing group of entities around a single center point
13. Computer function similar to stacking many pieces of paper on top of one another; allows different aspects of a drawing to be shown on different layers

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to create a CAD drawing using basic entities (e.g., lines, circles) and secondary entities (e.g., crosshatching) as components and to modify that drawing with the basic manipulation devices.

INFORMATION TOPIC: OR DEMONSTRATION: X

BASIC ENTITY INSERTION
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Produce a drawing on the classroom CAD system by inserting the following basic entities into the drawing field according to steps of procedures.

   a. Points

   b. Lines

   c. Circles

   d. Arcs

   e. Fillets

   f. Splines

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

**INFORMATIONAL ASSIGNMENT:** (Student)

**REFERENCES:** (Instructor's Additional Information)

See bibliography.

See glossary.

Erbes, John ed. Computer Aided Drafting Student Manual - MATC System.

INTRODUCTION:

If you can't create graphic entities, you can't make a drawing. In traditional drafting, you must use the basic tools - pencil, compass, and eraser--place the tools on the paper in the correct location and make marks.

When using CAD, the marks are dots of light on the display screen called "pixels" (picture elements). These marks still must be placed in the correct locations. This lesson will cover the correct entry and control of these dots of light.

(Note: This lesson covers basic entity insertion on a MATC CAD emulating system or a Computer Vision System 3. Other manufacturers' systems may differ in procedure or have a different collection of basic entities on file.)

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

STEPS OF PROCEDURES:

(Note: When any mode is activated, words may be typed in at keyboard or selected from tablet menu. Don't forget to include the colon.)

I. Inserting Points (Four Methods)

A. Specify location

1. Activate point mode: INS PNT:

2. Enter from keyboard the x-y coordinates of the desired point.

B. Digitize location (II-1)

1. Activate point mode: INS PNT:

2. Touch the graphics tablet with the stylus at the desired location.

C. Insert on

1. Activate point mode with "on" modifier: INS PNT ON:

2. Digitize or specify the entity on which the point is to be placed.

D. Insert at intersection (II-2)

1. Activate point mode with "INTOF" modifier: INS PNT INTOF:

2. Digitize or specify two intersecting entities.

3. Point will be inserted at projected intersection.

II. Inserting Lines (three methods)

A. Absolute coordinates

1. Activate line mode: INS LIN:

2. Enter from keyboard the x-y coordinates of each end of the line.

3. System will draw line from first specified point to second.

B. From the graphics tablet

1. Activate line mode: INS LIN:

2. On the tablet, touch two points in the drawing that will define the ends of the line.

3. System will draw line from first specified point to second.

C. Polar coordinates

1. Activate line mode: INS LIN:

2. Enter origin of line

a. As x-y coordinate

b. Or as a radius and a distance from system origin

3. Enter extent of line

a. As a radius and an angle

b. Example: R6 A30 will draw a line 6 inches long at a 30 degree angle to horizontal axis.

III. Inserting Circles (Five Methods)

A. Three points

1. Activate circle mode: INS CIR:

2. Digitize three points on the tablet.

3. System will draw circle through these three points.

B. Radius modifier (II-3)

1. Activate circle mode: INS CIR R:

2. Digitize two points

a. Circle's center

b. Circle's radius

C. Specified radius

1. Activate circle mode: INS CIR Rn:

2. Replace the n with a number representing the desired circle diameter.

3. Digitize circle's center.

4. System will construct circle.

D. Diametrical modifier

1. Activate circle mode: INS CIR D:

2. Digitize two points

   a. Circle's left diameter

   b. Circle's right diameter

3. System will construct circle.

E. Specified diameter

1. Activate circle mode: INS CIR Dn:

2. Replace the n with a number representing the desired circle diameter.

3. Digitize the circle's center.

4. System will construct circle.

IV. Inserting Arcs (Four Most Common Methods)

A. Three points on circumference

1. Activate arc mode: INS ARC:

2. Digitize three points on tablet.

3. System will draw arc through these three points.

4. End points will describe beginning and end of arc.

B. Digitized or specified radius

1. Activate arc mode: INS ARC Rn:

2. Replace the n with a number representing the desired arc radius if required.

3. Digitize arc's center.

4. Digitize arc's ends.

5. System will construct arc.

C. Digitized or specified diameter

1. Activate arc mode: INS ARC Dn:

2. Replace n with number representing the desired arc diameter.

3. Digitize arc's center.

4. Digitize arc's ends.

5. System will construct arc.

D. AGO and AEND modifiers

1. Activate arc mode: INS ARC AGOn AENDn:

2. Replace the n's with a number representing the desired arc beginning and/or ending angle from the horizontal.

3. Digitize arc's center.

4. System will construct arc.

V. Inserting Fillets (Three Methods) (II-4)

A. Digitize location

1. Activate fillet mode: INS FIL:

2. Digitize the two entities the fillet is to be tangent to.

3. System will construct fillet.

4. Arc will be drawn at system default radius.

5. System will automatically trim the existing entities to meet the new arc.

B. Digitize location with R modifier.

1. Activate fillet mode: INS FIL Rn:

2. Replace n with a number representing desired fillet radius.

3. Digitize the two entities the fillet is to be tangent to.

4. System will construct fillet.

5. System will automatically trim existing entities to meet the new arc.

C. Digitize location with no trim

1. Activate fillet mode: INS FIL NOTRIM:

2. R modifier may be used if desired.

3. Digitize two entities the fillet is to be tangent to.

4. System will construct fillet.

5. System will not trim existing entities to meet new arc.

VI. Inserting Splines

A. Activate spline mode: INS SPL:

B. Digitize all points along the spline.

C. System will draw the best curve through all digitized points.

VII. Summary and Conclusion

A. Inserting points

B. Inserting lines

C. Inserting circles

D. Inserting arcs

E. Inserting fillets

F. Inserting splines

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

INTERACTION ITEMS: (Review Items)

1. What does it mean to "digitize" a location?

2. Why would you want to insert a point at the intersection of two existing entities?

3. What is the difference between a circle's radius and a circle's diameter?

4. What is the difference between an arc and a fillet?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. Create a simple freehand sketch using the basic entity insertion skills learned in this lesson.

2. Using CAD, redraw a simple drawing from the first part of the traditional curriculum.

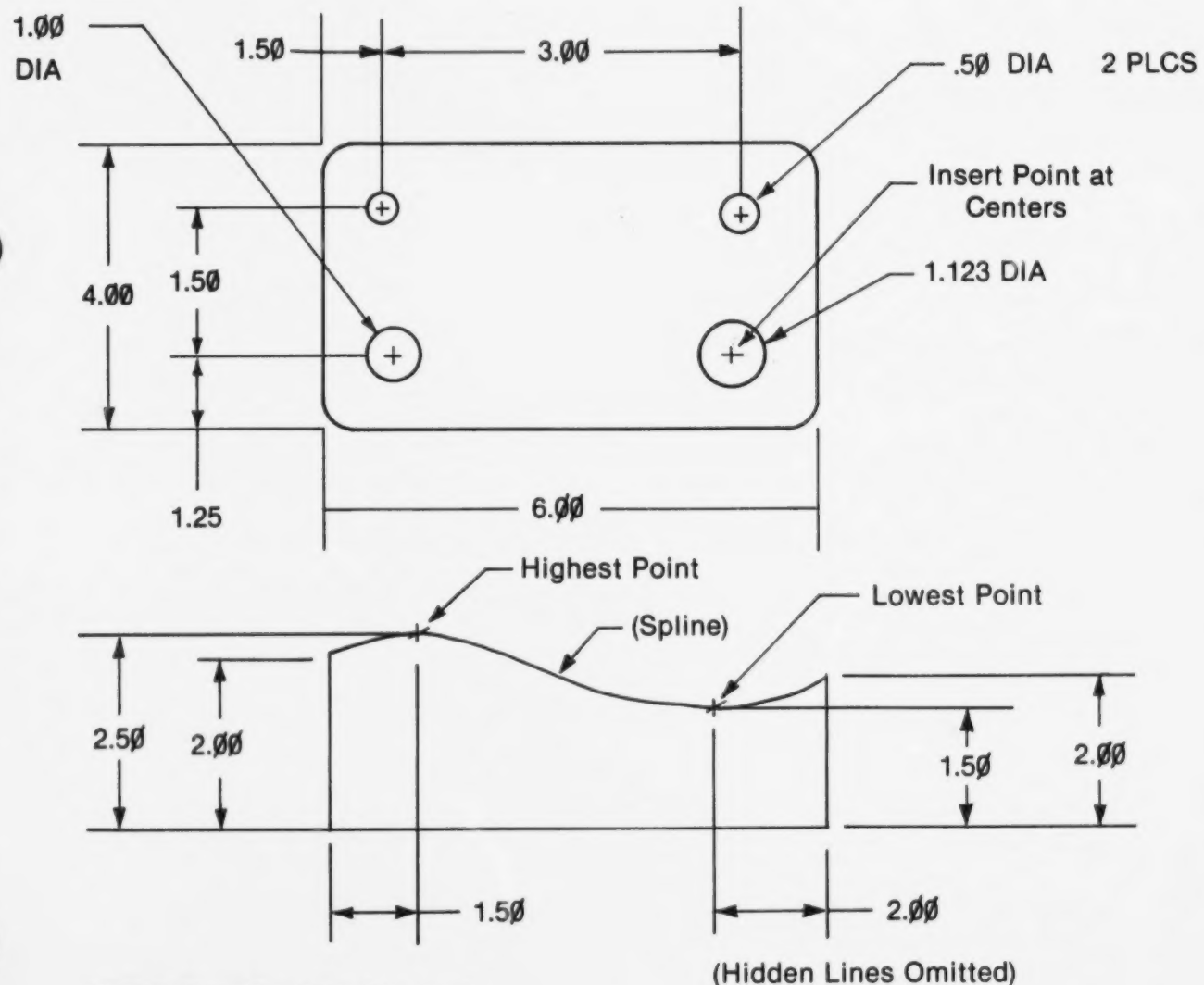
LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

EVALUATION ITEMS:

On the CAD system, construct the following drawing.
(Do not insert dimensions.)




NOTE: Drawing is not to scale.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

EVALUATION ITEMS:

| DID THE STUDENT: | YES | NO |
|---|---|---|
| I. Insert points (four methods). | | |
| A. Specify location.<br>1. Enter from keyboard the x-y coordinates of the desired point. | | |
| B. Digitize location.<br>1. Touch the graphics tablet with the stylus at the desired location. | | |
| C. Insert on.<br>1. Digitize or specify the entity on which the point is to be placed and its location on the entity. | | |
| D. Insert at intersection.<br>1. Digitize or specify two intersecting entities. | | |
| E. Insert point relative. Insert a point relative to existing entity(ies). | | |
| F. Insert point polar. Enter from the keyboard using polar coordinates. | | |
| II. Insert lines (three methods). | | |
| A. Absolute coordinates<br>1. Enter from keyboard the x-y coordinates of each end of the line. | | |
| B. From the graphics tablet<br>1. On the tablet, touch two points in the drawing that will define the ends of the line. | | |

| | | YES | NO |
|---|---|---|---|
| | C. Polar coordinates | | |
| | 1. Enter origin of line<br>a. As x-y coordinate | | |
| | b. Or as a radius and a distance from system origin | | |
| | 2. Enter extent of line as a radius and an angle. | | |
| III. | Insert circles (five methods). | | |
| | A. Three points<br>1. Digitize three points on the tablet. | | |
| | B. Radius modifier<br>1. Digitize circle's center and radius | | |
| | C. Specified radius<br>1. Replace the n with a number representing the desired circle diameter. | | |
| | 2. Digitize circle's center. | | |
| | D. Diametrical modifier<br>1. Digitize circle's left and right diameters | | |
| | E. Specified diameter<br>1. Replace the n with a number representing the desired circle diameter. | | |
| | 2. Digitize the circle's center. | | |
| IV. | Insert arcs (three most common methods). | | |
| | A. Three points on circumference<br>1. Digitize three points on tablet. | | |

| | | YES | NO |
|---|---|---|---|
| B. | Digitized or specified radius | | |
| 1. | Replace the n with a number representing the desired arc radius if required. | | |
| 2. | Digitize arc's center. | | |
| 3. | Digitize arc's ends. | | |
| C. | Digitized or specified diameter | | |
| 1. | Replace n with number representing the desired arc diameter. | | |
| 2. | Digitize arc's center. | | |
| 3. | Digitize arc's ends. | | |
| V. | Insert fillets (two methods). | | |
| A. | Digitize location. | | |
| 1. | Digitize the two entities the fillet is to be tangent to. | | |
| B. | Digitize location with no trim. | | |
| 1. | Digitize two entities the fillet is to be tangent to. | | |
| VI. | Insert splines. | | |

The student has satisfactorily completed the procedure "BASIC ENTITY INSERTION" according to the steps of procedures.

_____

Instructor's Signature
(Verifying Satisfactory Completion)

_____

Date

LESSON PLAN: 3

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to create a CAD drawing using basic entities (e.g., lines, circles) and secondary entities (e.g., crosshatching) as components and to modify that drawing with the basic manipulation devices.

INFORMATION TOPIC: OR DEMONSTRATION: X

SECONDARY ENTITY CREATION -- CROSSHATCHING
(Lesson Title)

LESSON OBJECTIVE - THE STUDENT WILL BE ABLE TO:

1. Produce a drawing on the classroom CAD system inserting specified crosshatching into boundary locations according to steps of procedures.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

French, T. et al. Mechanical Drawing 8th ed. New York: McGraw-Hill Book Co., 1985.

INTRODUCTION:

There are many symbols and conventions used in drafting to make a drawing easier to understand. Often these conventions are in the form of a code that is universally understood, making the drawing easier to read and speeding up the job of producing the drawing. In this lesson we will examine the use of some of these standard codes.

(Note: Other secondary entities may be available on systems from other manufacturers.)

LESSON PLAN: 3

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

STEPS OF PROCEDURES:

(Note: These procedures reflect the steps necessary to crosshatch an area on the MDX System Six CAD. The instructor should modify the outline as needed to reflect the procedures used for the classroom CAD system.)

I. Choosing the Crosshatch

A. Activate command XHATCH.

B. Select the pattern from the following choices.

1. X-hatch - general use
2. Alhatch - aluminum
3. Brasshatch1 - brass
4. Brasshatch2 - brass
5. Steelhatch1 - steel
6. Steelhatch2 - steel
7. Ironhatch1 - iron
8. Ironhatch2 - iron
9. Gridhatch - general use
10. Zinchatch - zinc

II. Choosing the Boundaries

A. Indicate the number of boundaries the pattern must cross.

1. Must be no greater than six
2. Digitize the boundary locations on the drawing.

B. To fill a complex shape, the process may have to be done in several parts.

C. System will automatically crosshatch the specified area.

III. Summary and Conclusion

A. Choosing the crosshatch

B. Choosing the boundaries

You now possess most of the skills needed to produce a CAD drawing; the remaining lessons will just make the job easier. Speed in the drawing process comes only after much practice. It will take awhile before you can produce a CAD drawing faster than a traditional drawing, but it's worth the time spent.

LESSON PLAN: 3

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

INTERACTION ITEMS: (Review Items)

1. When is crosshatching usually used?

2. What does aluminum crosshatching look like? (or brass or steel, etc.)

3. What is the difference between the crosshatching for iron and general crosshatching?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. Review the rules and techniques of sectioned drawings.

2. Use the CAD system to produce a chart of the various types of section crosshatching.

3. Report on military standards for using crosshatching in drawings. Discuss the pros and cons of using symbolic crosshatching or general crosshatching.

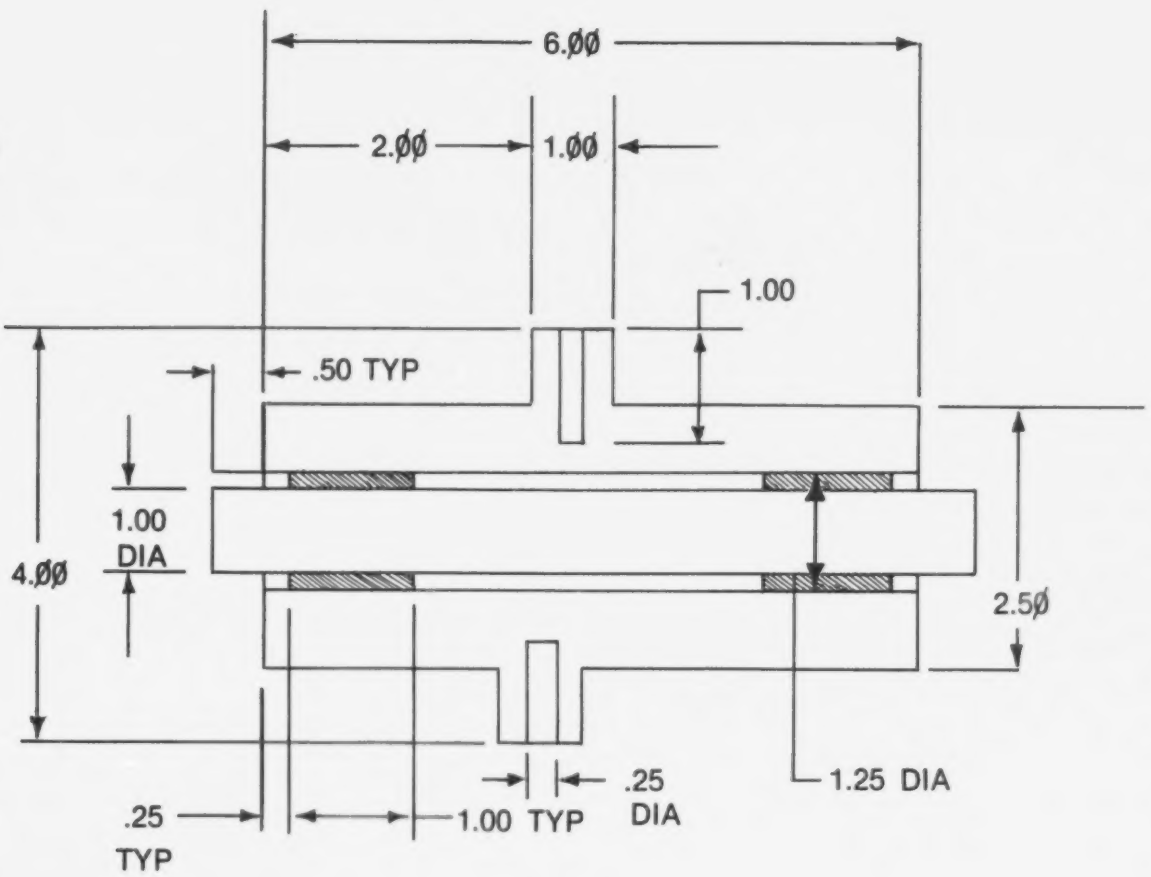
LESSON PLAN: 3

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

EVALUATION ITEMS:

Produce the following drawing on the classroom CAD system. (Note: Do not dimension) Crosshatch as required.



LESSON PLAN: 3

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

EVALUATION ITEMS:

| DID THE STUDENT: | YES | NO |
|---|---|---|
| I. Choose the crosshatch. | | |
| II. Choose the boundaries. | | |

The student has satisfactorily completed the procedure "SECONDARY ENTITY CREATION - CROSSHATCHING" according to the steps of procedures.

_____
Instructor's Signature
(Verifying Satisfactory Completion)

_____
Date

LESSON PLAN: 4

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to create a CAD drawing using basic entities (e.g., lines, circles) and secondary entities (e.g., crosshatching) as components and to modify that drawing with the basic manipulation devices.

INFORMATION TOPIC: OR DEMONSTRATION: X

DRAWING MANIPULATION
(Lesson Title)

LESSON OBJECTIVE - THE STUDENT WILL BE ABLE TO:

1. Produce a drawing on the classroom CAD system by manipulating entities using the following modes according to steps of procedures.

   a. Mirroring

   b. Moving

   c. Rotating

   d. Layering

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. TM 1: Mirroring
2. TM 2: Moving
3. TM 3: Rotating

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

It is not too far off base to think of CAD as graphic word processing. Many tasks are completed faster, corrections are easier, and repetitive tasks are eliminated. Once a group of entities is produced, copying, moving, and otherwise handling that group is simple. This lesson will deal with the drawing manipulation tools that release the drafter from repetition.

LESSON PLAN: 4

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

STEPS OF PROCEDURES:

(Note: These procedures are for the MATC CAD emulating system. Other systems may differ in precise procedure. The instructor should modify these outlines to reflect the necessary procedures for the classroom CAD system.)

I. Mirroring (TMI)

A. Activate mirror mode.

1. Enter MIR:

a. From keyboard

b. From tablet menu

2. Don't forget to include the colon. (II-1)

B. Select entities

1. By digitizing from current graphic input device

2. By absolute coordinates

C. Specify axis.

1. Axis data is separated from entity selection data by a semicolon.

2. Digitize or input coordinates of axis.

3. Two points are required to define the axis.

D. Press <RETURN>.

E. Typically the command would be: MIR:ENTD1 D2 D3; DIG D4 D5

1. The words that are underlined are prompts supplied by the computer - do not type them in.

2. The numbered "D's" represent digitized entries.

a. D1, D2, and D3 represent the entity selection digitized.

b. D4 and D5 specify rotation axis.

F. Options

1. Modifying MIR command with COPY command leaves existing entities intact.

2. Typically the command would be: MIR COPY:ENTD1 D2 D3; DIG D4 D5

3. Entities may also be selected with a window mask. (All entities within a specified window are mirrored)

4. Typically the command would be: MIR COPY:ENT WIN D1 D2; DIG D3 D4

a. D1 and D2 specify upper left and lower right corners of window.

b. D3 and D4 specify rotation axis.

II. Moving

A. To activate move mode, enter MOV: from keyboard or tablet menu.

B. Select entities:

1. By digitizing from current graphic input device.

2. By absolute coordinates.

C. Specify point to be moved and target location.

1. Location data is separated from the entity selection data by a semicolon.

2. Digitize or input coordinates of target from keyboard or tablet menu.

D. Press <RETURN>.

E. Typically the command would be: MOV:ENTD1 D2 D3; DIG D4 D5

1. D1 - D3 represent the entity selection digitized.

2. D4 and D5 specify point to be moved and target location, respectively.

F. Options

1. Modifying MOV command with COPY command leaves existing entities intact.

2. Typically the command would be: MOV COPY:ENTD1 D2 D3; DIG D4 D5

3. Entities may also be selected with a window mask.

4. Typically the command would be: MOV COPY:ENT WIN D1 D2; DIG D3 D4

a. D1 and D2 specify upper left and lower right corner of window.

b. D3 and D4 specify point to be moved and target location, respectively.

III. Rotating

A. To activate rotate mode, enter ROT: from keyboard or tablet menu.

B. Select entities.

C. Specify point to be rotated and target location.

1. The location data is separated from the entity selection data by a semicolon.

2. Digitize or input the coordinates of the target from keyboard or tablet menu.

D. Press <RETURN>.

E. Typically the command would be: ROT:ENTD1 D2 D3; DIG D4

1. D1, D2, and D3 represent the entity selection digitizes.

2. D4 would be used to specify the rotation axis.

F. Options

1. Modifying ROT command with COPY command leaves existing entities intact.

2. Typically the command would be: ROT COPY:ENTD1 D2 D3; DIG D4 D5

   a. D1, D2, and D3 represent entity selection digitizes.

   b. D4 would be used to specify rotation axis.

3. Entities may also be selected with a window mask.

4. Typically the command would be: ROT COPY:ENT WIN D1 D2; DIG D3 D4

   a. D1 and D2 specify the upper left and the lower right corner of the window.

   b. D3 would be used to specify the rotation axis.

## IV. Layers

### A. Suggested guidelines for using layers (II-4)

1. Use layers 1-9 for main drawing (object lines)

2. Use layers 10-19 for hidden lines.

3. Use layers 20-29 for dimensions.

4. Use layers 30-39 for format (title, border, etc.)

5. Use layers 40-49 for notes and text.

6. Use layers 50-59 for crosshatching and other secondary entities.

7. Other more or less complex arrangements may be used.

   a. These guidelines are suggestions only.

   b. The operator should arrive at some standard arrangement, however.

### B. Using layers (four commands)

1. Select layer

   a. Select current "construction" layer.

   b. After a layer is selected, all entities will be placed in that layer.

c. Construction layer is always visible.

2. Echo layer

   a. Makes all selected layers visible

   b. Construction layer is always visible.

   c. After layer selection is completed, a repaint must be performed to display layers added to or removed from the "stack."

   d. To remove a layer, use an "m" (meaning minus) suffix.

   e. To add a layer, use a "p" (meaning plus) suffix.

   f. To show all layers, enter ECH LAY ALL.

   g. To show construction layer only, enter ECH LAY n where n is the number of the construction layer.

3. List layer

   a. Used to display a list of layers echoed, current construction layer, and which layers contain entities

   b. To list construction layer and layers echoed, enter LIST LAY.

   c. To list layers that contain entities, enter LIST LAY USED.

4. Moving an entity to another layer

   a. Enter command CHG LAY n: ENTD1 D2

      (1) The n represents the number of the target layer.

      (2) Entities are always moved from the construction layer.

      (3) D1, D2, etc. represent the digitizing or the specification of the entities to be moved.

   b. Press <RETURN> to complete operation.

V. Summary and Conclusion

A. Mirroring

B. Moving

C. Rotating

D. Layers

This lesson contains a lot of information. However, once these skills are learned, much drawing and redrawing time can be saved. Again, the only way to become familiar with these commands is to use them, so, practice, practice practice.

LESSON PLAN: 4

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

INTERACTION ITEMS: (Review Items)

1. What are the two ways to input data?

2. What is a selection window?

3. What is the major difference between mirroring and rotating entities?

4. Using layers could be compared to what traditional drafting process?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. Have the students practice using the copy, move, mirror, amd rotate commands on the classroom CAD system.

2. Have the students practice echoing, listing, and moving entities from one layer to another using the layering commands.

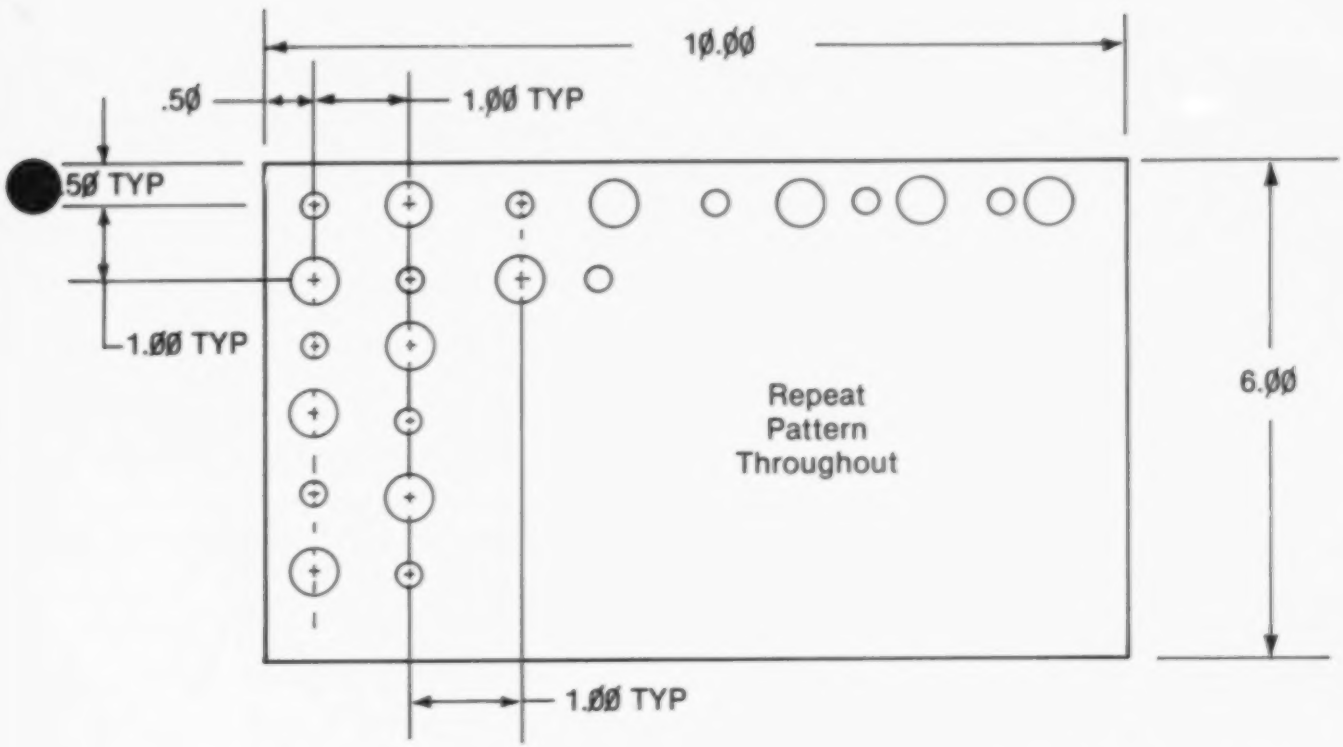
LESSON PLAN: 4

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

EVALUATION ITEMS:

Produce the following drawing on the classroom CAD system. Place outline on layer 1, large holes on layer 5, and small holes on layer 10. Do not dimension.




Small Holes: .375 DIA
Large Holes: .875 DIA

LESSON PLAN: 4

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VII : CREATING A DRAWING WITH A CAD SYSTEM

EVALUATION ITEMS:

| DID THE STUDENT: | | YES | NO |
|---|---|---|---|
| I. | Mirror entities. | | |
| II. | Move entities. | | |
| III. | Rotate entities. | | |
| IV. | Manipulate layers. | | |
| | A. Select layer. | | |
| | B. Show layer. | | |
| | C. List layer. | | |
| | D. Move an entity to another layer. | | |

The student has satisfactorily completed the procedure "DRAWING MANIPULATION" according to the steps of procedures.

_____
Instructor's Signature
(Verifying Satisfactory Completion)

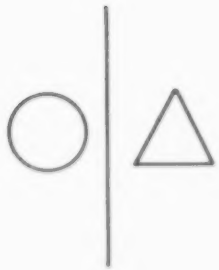
_____
Date

## Example One

Basic mirror

Before

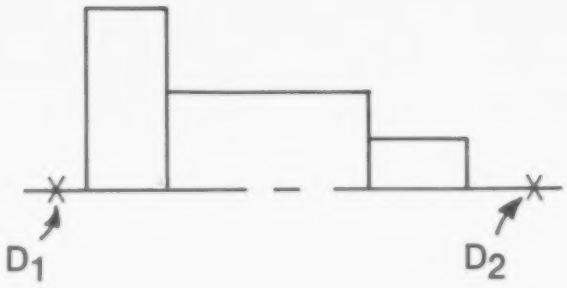
After



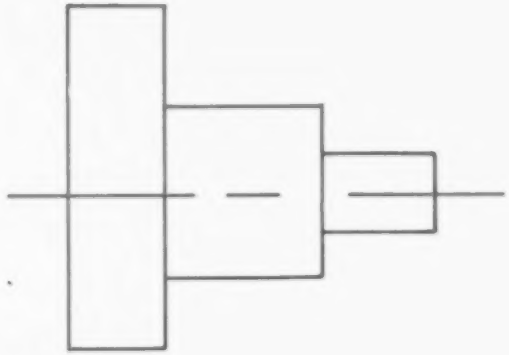
## Example Two

Mirror w/copy

Before




After



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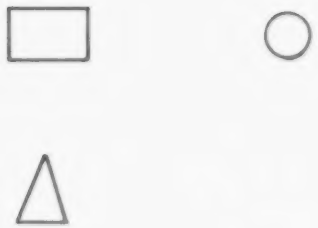
# Mirroring

## Example One

Basic move

Before

After



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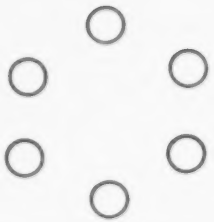
## Example Two

Move w/copy

Before

After



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# Moving

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TM 2

## Example One

Basic rotate

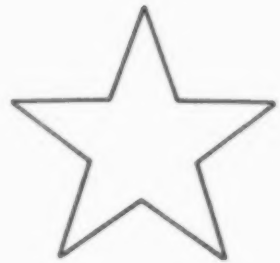
Before

After

## Example Two

Before

After



# Rotating

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VIII : TEXT INSERTION

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to add text and dimension to drawings.

INFORMATION TOPIC: X OR DEMONSTRATION:

TERMINOLOGY FOR INSERTING DIMENSIONS AND TEXT
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Define terms relating to the insertion of dimensions, notes, and ancillary text in CAD drawings.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

Drafting is essentially communication. The drawing itself communicates in graphic form but the graphic must usually be enhanced by textual communication in the form of dimensions or notes.

In this lesson we will become familiar with the terms and definitions related to inserting notes, dimensions, and text.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VIII : TEXT INSERTION

OUTLINE: (Key Points)

I. Terms Related to Dimensioning

A. Linear dimension

1. Any dimension measuring a distance between two points

2. May be horizontal, vertical, or point-to-point

B. Radial dimension (II-I)

1. Any dimension measuring a circle based on the circle's radius

2. Can be used on either arcs or circles

C. Diametrical dimension (II-2)

1. Any dimension measuring a circle based on the circle's diameter.

2. Can be used on either arcs or circles but is usually reserved for circles.

II. Terms Related to Text

A. Text

1. Any notes or writing placed anywhere on the drawing field

2. Examples are names, dates, additional instructions, process notes

B. Delimiter (II-3)

1. A symbol placed at the beginning and end of a block of text

2. Examples are quote marks ("), single quote marks ('), and slashes (/).

C. Text height - a measurement from the top to the bottom of a typical upper case letter

D. Text width - a measurement specified as a percentage of the height

E. Text slant

1. Amount of nonvertical tendency in the text

2. Slant can be from +45 to -45 degrees from the vertical.

3. Default text slant is 0 degrees.

F. Text angle

1. The slant of the base guide line of the text

2. Horizontal is 0 degrees slant.

3. Default is 0 degrees.

G. Left-justified text - all lines of text are aligned at the left margin. (II-4)

H. Right-justified text - all lines of text are aligned at the right margin.

I. Center-justified text - an equal number of spaces are in the left and right margins.

III. Summary and Conclusion

A. Terms related to dimensioning

B. Terms related to text

Now that you have a basic familiarity with the terms related to dimensioning and text insertion, we will learn to apply the commands and techniques the drafter must use to accomplish dimensioning and text insertion on the classroom CAD system.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VIII : TEXT INSERTION

INTERACTION ITEMS: (Review Items)

1. A radius is what part of a circle?
2. A diameter is what part of a circle?
3. What symbols can be used as delimiters?
4. What are three ways text can be aligned (justified)?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VIII: TEXT INSERTION

EVALUATION ITEMS:

Match the following terms with their definitions below.

| | | | |
|---|---|---|---|
| A. | Linear dimension | G. | Text width |
| B. | Radial dimension | H. | Text slant |
| C. | Diametrical dimension | I. | Text angle |
| D. | Text | J. | Left-justified text |
| E. | Delimiter | K. | Right-justified text |
| F. | Text height | L. | Center-justified text |

_____ 1. All lines of text are aligned at the left margin.

_____ 2. A measurement from the top to the bottom of a typical upper case letter

_____ 3. Any dimension measuring a circle based on the circle's radius

_____ 4. A symbol placed at the beginning and end of a block of text

_____ 5. Any dimension measuring a horizontal, vertical or angular distance between two points

_____ 6. All lines of text are aligned at the right margin.

_____ 7. An equal number of spaces are in the left and right margins.

_____ 8. Amount of nonvertical tendency in the text

_____ 9. Any notes or writing placed anywhere on the drawing field

_____ 10. The slant of the base guide line of the text

_____ 11. A measurement specified as a percentage of the height

_____ 12. Any dimension measuring a circle based on the circle's diameter

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VIII : TEXT INSERTION

ANSWERS TO EVALUATION ITEMS:

1. J
2. F
3. B
4. E
5. A
6. K
7. L
8. H
9. D
10. I
11. G
12. C

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VIII : TEXT INSERTION

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to add text and dimension to drawings.

INFORMATION TOPIC: OR DEMONSTRATION: X

DIMENSIONS, NOTES, AND ANCILLARY TEXT
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. Produce a drawing on the classroom CAD system by utilizing the following procedures, according to steps of procedures

   a. Insert radial dimensions.

   b. Insert diametrical dimensions.

   c. Insert horizontal dimensions.

   d. Insert vertical dimensions.

   e. Insert point to point dimensions.

   f. Change existing dimensions.

   g. Insert text.

   h. Change existing text.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

The soul of any engineering drawing is the dimensions. Computer aided drafting greatly simplifies the task of dimensioning. The computer's data base keeps records of all the sizes, lines, and locations of all entities. This information can be displayed on command. This unit will discuss most of the dimensioning techniques and commands needed to dimension a CAD drawing as well as add notes and other kinds of text.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VIII : TEXT INSERTION

STEPS OF PROCEDURES:

(NOTE: This outline reflects the procedures for dimensioning and adding text on a MATC CAD emulating system. The instructor should modify the outline as needed to reflect the procedures for the classroom CAD system.)

I. Inserting Radial and Diametrical Dimensions

A. Select command.

1. INS RDIM: ENT D1 DIG D2 for radial dimensions

2. INS DDIM: ENT D1 DIG D2 for diametrical dimensions.

3. The letters may be typed in or selected from the graphics tablet menu.

4. Don't forget to include the colon.

5. D1 represents the selection of the arc or circle to be dimensioned.

6. D2 represents the lower left corner of the text of the dimension.

B. Press <RETURN>.

1. Dimension will be placed at the location of the second digitized point (D2).

2. The dimension leader line will point to the left edge of the text.

C. Do not enter the underlined part of the command.

1. The underlined text is supplied by the computer as prompts.

2. The operator should simply respond to the prompts.

II. Inserting Linear Dimensions

A. Horizontal dimensions

1. Used to dimension a horizontal distance within a drawing

2. Activate horizontal dimension mode with: INS LDIM HOR: END D1 D2 DIG D3

B. Vertical dimensions

1. Used to dimension a vertical distance within a drawing

2. Activate vertical dimension mode with: INS LDIM VER: END D1 D2 DIG D3

C. Point-to-point dimensions (II-1)

1. Used to dimension a distance between two points in a drawing.

2. Activate point to point dimension mode with: INS DIM: END D1 D2 DIG D3

D. For all three types of linear dimensioning

1. D1 and D2 are used to specify the ends of the lines or points to be dimensioned.

2. D3 specifies the lower right corner of the dimension text.

3. Dimension will be placed at the location of the second digitized point (D3).

4. The dimension leader line will point to the left edge of the text.

III. Changing Existing Dimensions (II-2)

A. The process of changing a dimension consists of changing one or more of the dimension's attributes.

1. Origin (ORG)

a. Change the dimension's origin by digitizing the origin of an existing dimension and then the desired new location.

b. The origin of a dimension is at the lower left hand corner of the dimension.

2. Text (TXT)

a. Replace existing dimension text with different text.

b. Use the single quote (') as a delimiter when specifying new text.

3. Suppression (SUPn)

a. Change the suppression status of the extension and dimension lines of a dimension.

b. The "n" should be replaced with a representative number from the following list.

(1) 0 - All lines present

(2) 1 - First extension line suppressed

(3) 2 - Second extension line suppressed

(4) 3 - Both extension lines suppressed

(5) 4 - Suppress first dimension and the first extension line

(6) 5 - Suppress second dimension and second extension line

(7) 6 - Suppress all extension and dimension lines

4. Height (HGTn)

a. Change the height of the existing text to a specified height.

b. The "n" should be replaced with the new height.

5. Arrows in (AI)

a. Place the arrows inside the extension lines.

b. Dimension text may be either inside or outside of the extension lines.

6. Arrows out (AO)

a. Place the arrows outside the extension lines.

b. Dimension text may be either inside or outside the extension lines.

B. How to change dimensions

1. Activate mode with CHG DIM (modifier): ENT D1 DIG D2

   a. D1 selects the origin of the dimension to be changed.

   b. D2 indicates new location of attribute or dimension.

      (NOTE: D2 is not always required.)

2. Press <RETURN> and system will make change and update data base.

IV. Inserting Text

A. Select a command (II-3)

1. INS TXT/(text goes here)/(modifiers): DIG D1

2. The command may be entered from the keyboard or from the graphic tablet menu.

3. The text must be enclosed by a delimiter.

   a. Underlined text is supplied by the system as a prompt.

   b. Do not type in underlined text.

4. D1 represents the desired location of the origin of the text to be inserted.

5. Modifiers can be selected from the following list

   a. HGTn - Specifies height of text

   b. ANGn - Specifies base line angle of text

   c. SLTn - Specifies slant of text

   d. WDTn - Specifies width of text

   e. CJT - Specifies center-justified text

   f. RJT - Specifies right-justified text

   g. LJT - Specifies left-justified text (default).

B. Press <RETURN>, and the system will insert text in specified location.

V. Changing Existing Text (II-7)

A. Select command

1. CHG TXT (modifier):ENT D1

2. The command may be entered from the keyboard or from the graphic tablet menu.

a. Note: Underlined text is supplied by the system as a prompt.

b. Do not type in underlined text.

3. D1 represents the location of the origin of the text to be changed.

4. Modifiers can be selected from the following list.

a. HGTn - Changes height of existing text.

b. ANGn - Changes base line angle of existing text.

c. SLTn - Changes slant of existing

d. WDTn - Changes width of existing text.

e. CJT - Changes existing text to center justified text.

f. RJT - Changes existing text to right justified text.

g. LJT - Changes existing text to left justified text (default).

B. Press <RETURN> and the system will change the text at the specified location.

VI. Summary and Conclusion

A. Inserting radial and diametrical dimensions

B. Inserting linear dimensions

C. Changing dimensions

D. Inserting text

E. Changing text

Once the principles of inserting dimensions and text are mastered, the job of learning to operate a CAD system is essentially complete. Other skills are helpful but not necessary.

The next two units will cover these optional skills of CAD. However, the mastery of CAD is not finished. The student must continue to practice and increase operating speed to be employable.

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VIII : TEXT INSERTION

INTERACTION ITEMS: (Review Items)

1. If LDIM HOR is used for horizontal dimensions and LDIM VER is used for vertical dimensions what do you think is used for point to point dimensions?

2. Why would you want to change a dimension?

3. Why are slashes needed in the command and what are they called?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. The student should produce a number of practice drawings that require all the CAD skills covered so far. Emphasis should be on completeness, correctness, and speed. Once the basic skills are mastered, the student should be encouraged to create a complete drawing quickly.

2. If possible, the dimensioning process for other CAD systems should be examined. A field trip to a supplier's sales facility or an industry CAD installation would give students a broader picture of how CAD is used.

3. The student should redraw on CAD drawings that were done earlier in the program using traditional drawing techniques.

4. The student should attempt to copy complex drawings freehand. The finished drawing should be as complete as possible. Good projects for an assignment of this type would be a drawing of the space shuttle or a 10-speed bicycle. Also good are the Star Trek blueprints available at many bookstores. (The bicycle project is more difficult than it first appears. Good drawings or photographs of bicycles can be found in advertising literature.)

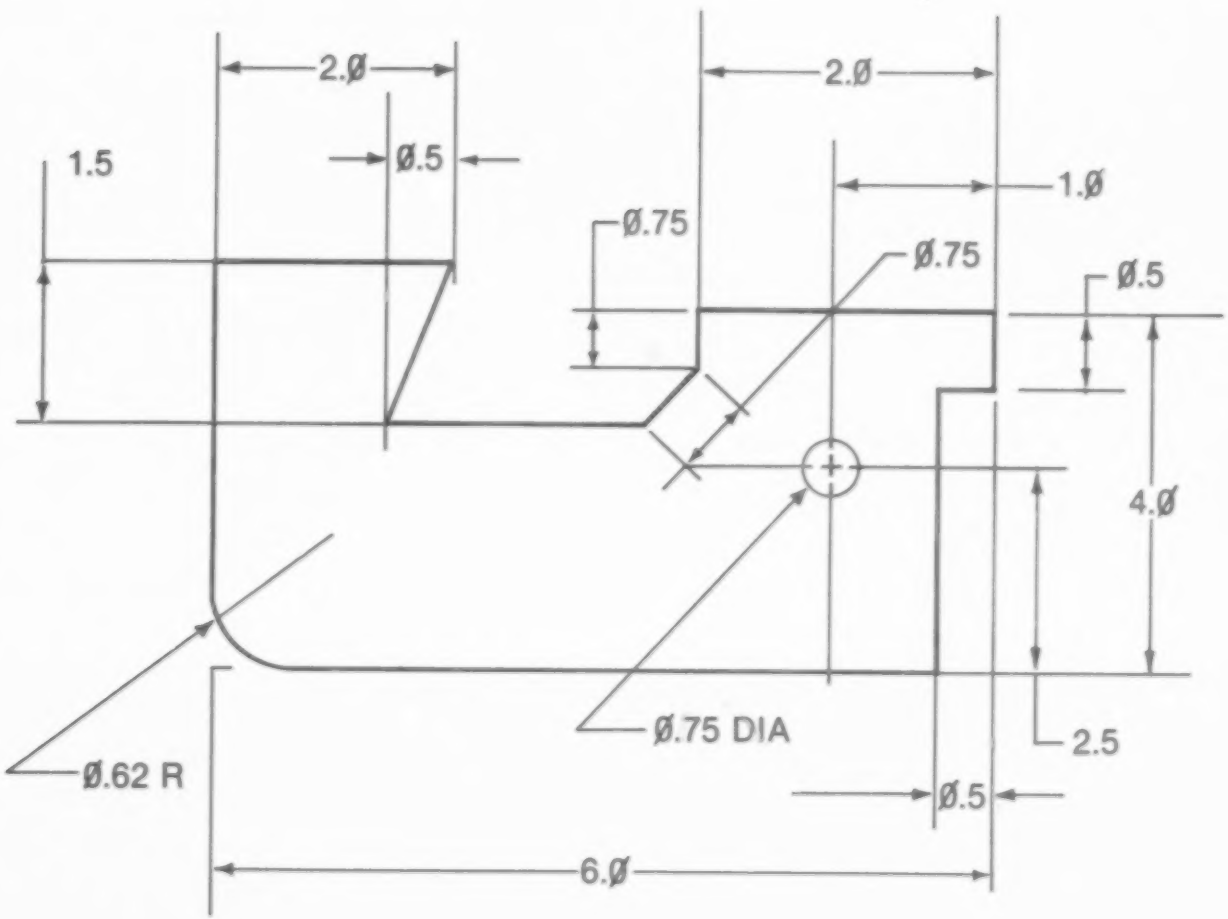
LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

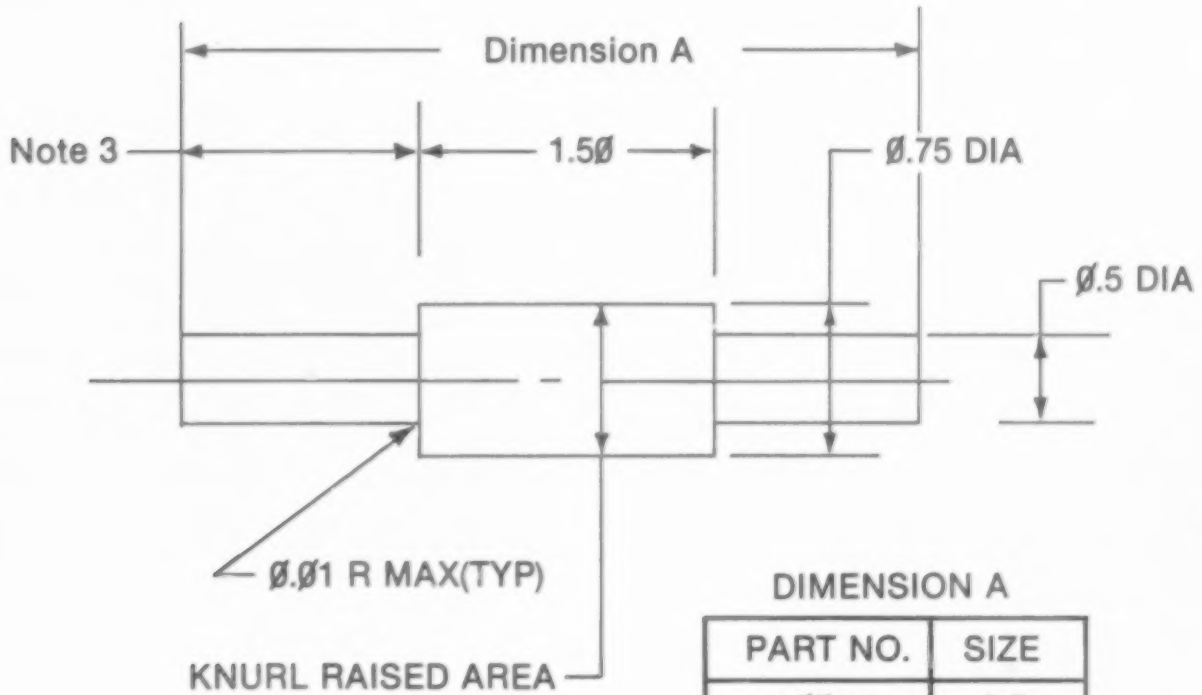
UNIT VIII : TEXT INSERTION

EVALUATION ITEMS:

1. Create and dimension the following drawing.
   Place all dimensions on layer 10.



2. Draw and dimension the following drawing. Include all notes. Place all dimensions on layer 10 and all notes on layer 20.




DIMENSION A

| PART NO. | SIZE |
|---|---|
| 1ØØ1-A | 6.Ø |
| 1ØØ1-B | 6.5 |
| 1ØØ1-C | 7.Ø |
| 1ØØ1-D | 7.5 |

3. Break all sharp edges.
2. Material to be 1Ø4Ø Steel.
1. This dimension is found with the formula: (DIM A - 1.5Ø)/2.

Notes:

LESSON PLAN: 2

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT VIII : TEXT INSERTION

EVALUATION ITEMS:

| DID THE STUDENT: | | YES | NO |
|---|---|---|---|
| I. | Insert radial dimensions. | | |
| | A. Select command. | | |
| | B. Press <RETURN>. | | |
| II. | Insert diametrical dimensions. | | |
| | A. Select command. | | |
| | B. Press <RETURN>. | | |
| III. | Insert horizontal dimensions. | | |
| IV. | Insert vertical dimensions. | | |
| V. | Insert point to point dimensions. | | |
| VI. | Change existing dimensions attributes, using these characteristics: | | |
| | A. Origin | | |
| | B. Text | | |
| | C. Supression | | |
| | D. Height | | |
| | E. Arrows in | | |
| | F. Arrows out | | |

| | | YES | NO |
|---|---|---|---|
| VII. | Insert text attributes using these characteristics. | | |
| | A. Height | | |
| | B. Base line angle | | |
| | C. Slant | | |
| | D. Width | | |
| | E. Center-justified | | |
| | F. Right-justified | | |
| | G. Left-justified | | |
| VIII. | Change existing text attributes using these characteristics: | | |
| | A. Height | | |
| | B. Base line angle | | |
| | C. Slant | | |
| | D. Width | | |
| | E. Center-justified | | |
| | F. Right-justified | | |
| | G. Left-justified | | |

The student has satisfactorily completed the procedure "DIMENSIONS, NOTES, AND ANCILLARY TEXT" according to the steps of procedures.

_____
Instructor's Signature
(Verifying Satisfactory Completion)

_____
Date

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IX : EDITING EXISTING DRAWINGS

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to create a new drawing from an existing drawing.

INFORMATION TOPIC: OR DEMONSTRATION: X

CREATING NEW DRAWINGS FROM OLD
(Lesson Title)

LESSON OBJECTIVE - THE STUDENT WILL BE ABLE TO:

1. Create a new drawing from an existing one according to steps of procedure.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

One of the major advantages of CAD is the reduction of repetition and redrawing. Once a drawing is made it need never be redrawn. This lesson will examine the procedure for producing new drawings from older but similar drawings, eliminating repetition.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IX : EDITING EXISTING DRAWINGS

STEPS OF PROCEDURE:

(NOTE: The following procedure reflects the steps required to create a new drawing similar to an existing one on a MATC CAD emulating system. Other systems may have different requirements. The instructor should modify the outline below to reflect the requirements of the classroom CAD system.)

I. Creating New Drawings From Existing Ones

A. Copy existing drawing using standard file-copying procedures.

1. Procedure varies depending on software and equipment available.

2. Repeat if necessary.

B. Rename new file. (II-1)

C. Call new file into system.

D. Use standard procedures for loading a drawing into system for revisions.

E. Make revisions using standard drawing procedures.

F. Save updated drawing using standard file-saving techniques. (II-2)

II. Summary and Conclusion

Creating new drawings from existing ones

The next lesson will cover the mechanics of the CAD system symbol library. You will learn how to use this time-saving function on the classroom CAD system to assist you in creating drawings as quickly and as efficiently as possible.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IX : EDITING EXISTING DRAWINGS

INTERACTION ITEMS: (Review Items)

1. Why do you need to rename the new file?
2. How do you save a drawing?

CLASSROOM, LABORATORY, SHOP, OR OTHER ACTIVITIES:

1. Students should practice the copy, recall, update, and save procedures using several existing drawings. A good method would be to add dimensions to drawings produced earlier in the program, leaving the existing drawings unchanged.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT IX : EDITING EXISTING DRAWINGS

EVALUATION ITEMS:

| DID THE STUDENT: | YES | NO |
|---|---|---|
| I. Create new drawings from existing ones | | |
| A. Copy existing drawing using standard file copying procedures. | | |
| B. Rename new file. | | |
| C. Call new file into system. | | |
| D. Use standard procedures for loading a drawing into system for revisions. | | |
| E. Make revisions using standard drawing procedures. | | |
| F. Save updated drawing using standard file-saving techniques. | | |

The student has satisfactorily completed the procedure "CREATING NEW DRAWINGS FROM OLD" according to the steps of procedure.

_____
Instructor's Signature
(Verifying Satisfactory Completion)

_____
Date

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT X : THE CAD LIBRARY

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to gain access to and use symbols in a CAD library.

INFORMATION TOPIC: OR DEMONSTRATION: X

USING THE SYMBOL LIBRARY
(Lesson Title)

LESSON OBJECTIVE - THE STUDENT WILL BE ABLE TO:

1. Create library symbols on a drawing on the classroom CAD system according to steps of procedure.

2. Insert a part or symbol on a drawing on the classroom CAD system according to steps of procedure.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

INFORMATIONAL ASSIGNMENT: (Student)

The student should read any "machine specific" information pertaining to the symbol library.

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

All engineering drawings are symbolic. The language of graphics is by definition symbolic, and the standardization of symbols can be compared to the standardization of any other language.

Elimination of repetition is one of the major benefits of CAD and prepared symbols increase this efficiency. The ability to "plug in" a standard symbol as needed can greatly speed drawing production. This unit will examine the use of these symbols.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT X : THE CAD LIBRARY

STEPS OF PROCEDURE:

I. Terms and Definitions

A. Symbol library

1. A collection of standard symbols

2. A library is often organized into divisions by related symbols. (II-1)

a. Electronic symbols

b. Architectural symbols

c. Others

B. Library disk

1. A diskette that contains a symbol library

2. Normally, a diskette would contain only one group of related symbols.

a. Electronic symbols

b. Architectural symbols

c. Others

C. Parts disk

1. A diskette that contains a current, stored drawing

2. Symbols can be added to the parts disk to aid in the completion of the drawing.

D. Part

1. A collection of entities that can be inserted into an existing drawing

2. May be an existing detail drawing

a. An assembly drawing can be created by combining existing detail drawings.

b. New drawings would have to be modified for occurrence of hidden lines.

3. May be a standard part or other collection of entities.

4. A part is inserted on the same layer that it was originally created on unless otherwise specified.

5. Only one part per command may be inserted.

E. Figure

1. A drawing that is treated as a single entity when inserted

2. The geometry of a figure cannot be manipulated.

3. The entire figure is inserted on the existing drawing layer.

4. A figure may be inserted many times per command.

(NOTE: The following procedure represents the steps needed to utilize the symbol library in a MATC CAD emulating system. Other systems may be different. The instructor should modify the following outline to reflect the needs of the classroom CAD system.)

II. Procedure for Creating a Library Symbol

A. Select the part disk or disks needed to support the drawing in progress.

1. Electronic symbols

2. Architectural symbols

3. Others

B. Create the basic drawing using normal CAD procedures.

C. When a symbol is needed, enter the symbol library command INS PRT/partname/modifiers: DIG D.

D. Press <RETURN>.

E. Part name

1. The part name is the name of a previously created and stored part to be inserted into the current drawing.

2. The exact name must be typed between the slashes.
3. All normal rules for part names apply.

   a. Numbers or letters only

   b. Must start with a letter

   c. Maximum of seven characters

4. The D represents the origin of the part to be inserted.

   a. That is, the location of XOYO when part was created

   b. Only one digitized point is required.

   c. Do not enter the underlined text.

F. Modifiers (II-2)

1. SCL n

   a. Used to scale the part (figure) relative to the existing drawing

   b. A number greater than one causes an increase in scale.

   c. A number less than one causes a decrease in scale.

   d. The scale modifier causes all entities to be scaled relative to the origin of the symbol being inserted.

2. ANG n

   a. Rotates the part (figure) to a specified angle

   b. Rotates clockwise around origin

   c. Default is no rotation.

3. LAY n

   a. Causes part to be inserted into existing drawing on specified layer

b. If no layer is specified, the part will be inserted on the same layer on which the symbol was originally constructed.

c. Does not apply to figure insertion

4. MIR

a. This modifier inserts the figure as a mirror image.

b. Mirroring axis is a vertical line through the figure's origin.

c. Mirroring is performed before rotation if both modifiers are used.

d. Does not apply to part insertion

III. Procedure for Specifying the Insertion of a Part or a Symbol

A. To insert part (Example: a part called PRES.SW)

1. Enter the command INS PRT/PRES.SW/: DIG END

2. Press <RETURN>.

B. To insert symbol (Example: a symbol called MOMT>SW)

1. Enter the command INS PRT/MOMT.SW/: DIG END

a. The part/symbol name is enclosed in slashes.

b. The "END" modifier causes the part/symbol to be placed at the end of an existing entity.

c. Do not enter the underlined text.

2. Press <RETURN>

3. Digitize the location of the part's/symbol's origin in the new drawing.

4. Press <RETURN>.

5. System will prompt: Insert library disk in parts drive and press <RETURN> to continue.

a. Replace drawing disk in drive 2 with library disk

b. Press <RETURN>.

Note: if part is larger than about 100 entities, you will need to reinsert the drawing disk.

6. Repeat a and b of step 5 as needed.

C. If part or symbol is not found on library disk, disk error message will appear.

1. Replace drawing disk in drive 2.

2. Press <RETURN>.

D. If part or symbol is found, it will be placed in the drawing at the specified location.

1. When prompted, replace drawing disk in drive 2.

2. Press <RETURN>.

IV. Summary and Conclusion

A. Terms and definitions

B. Procedure for creating a library symbol

C. Procedure for specifying the insertion of a part or symbol

This completes the study of CAD drawing creation. You now have all the basic CAD drawing skills at your disposal. The only thing that is left to do is to print out or plot your drawing and put it to use. However, your job of learning is not over. You must continue to practice and increase your speed and accuracy with a CAD system.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT X: THE CAD LIBRARY

INTERACTION ITEMS: (Review Items)

1. Why would an electronic symbols disk be needed?

2. What are modifiers in CAD?

3. What is the basic difference between a part and a figure?

CLASSROOM, LABORATORY, SHOP, OR OTHER ACTIVITIES:

1. Assign different students to create or enhance library disks. Suggestions for classroom library disks are:

   Electronic symbols
   Architectural symbols
   Piping symbols
   Room layout templates
   Landscaping figures
   Flow charting symbols
   Civil engineering symbols
   Structural steel templates

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT X : THE CAD LIBRARY

EVALUATION ITEMS:

| DID THE STUDENT: | YES | NO |
|---|---|---|
| I. Create a library symbol. | | |
| II. Specify the insertion of a part or a symbol. | | |

The student has satisfactorily completed the procedure "USING THE SYMBOL LIBRARY" according to the steps of procedure.

Instructor's Signature
(Verifying Satisfactory Completion)

Date

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT XI : OUTPUT DEVICES

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to identify the various types of output devices used with CAD systems.

INFORMATION TOPIC: X OR DEMONSTRATION:

GRAPHIC OUTPUT DEVICES
(Lesson Title)

LESSON OBJECTIVES - THE STUDENT WILL BE ABLE TO:

1. List the two basic types of printers.
2. List two advantages and two disadvantages to use of printers with CAD.
3. List the two basic types of plotters.
4. List two advantages and two disadvantages to use of plotters with CAD.
5. List two advantages and two disadvantages to use of laser printers with CAD.
6. List two advantages and two disadvantages to use of electrostatic plotters with CAD.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

1. TM 1: Printer
2. TM 2: Plotter
3. TM 3: Laser Printer

INFORMATIONAL ASSIGNMENT: (Student)

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

For a drawing to be usable, it must be in the form of a hard copy. That is, the drawing must be printed or reproduced on paper.

The devices used to transfer the information from an electronic (soft copy) form to a paper (hard copy) form are called output devices. This unit will examine most of the common graphic output devices in use with CAD.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT XI : OUTPUT DEVICES

OUTLINE: (Key Points)

I. Printers (TM-1)

A. Two major types

1. Daisy wheel or other type of letter quality printer

a. Can print only letters (alpha output)

b. Cannot be used to output CAD drawings

2. Dot matrix or dot addressable

a. Can be used to print letters (alpha output) or drawings (graphic output)

b. The letters are broken into a pattern of dots.

c. Each dot in the letter matrix can be commanded (addressed) separately to produce lines and pictures.

B. Advantages of printers in CAD

1. Speed - drawings can usually be printed in a minute or two

2. Low cost - usually less than $1,000

3. Versatility - can be used for both alpha and graphic output

C. Disadvantages of printers in CAD (II-1)

1. Size - drawings are rarely printed to scale

2. Low quality of output - drawings are represented as a series of closely spaced dots rather than continuous lines

II. Plotters (TM-2)

A. Two major types

1. Flat bed plotter

   a. Paper lies flat on a platform.

   b. Paper may be clamped in place.

2. Drum plotter

   a. Paper is clamped to a rotating cylinder.

   b. Pens move horizontally; drum rotates to produce vertical lines.

B. Advantages

1. Accuracy - drawings usually are reproduced to scale.

2. Reproducibility - drawings can be plotted on traditional materials and blueprinted normally.

C. Disadvantages

1. Cost - Some plotters may cost as much as $25,000

2. Size - drawing size may be limited by the size of the plotter

3. Speed - complex drawing may require several hours to plot

III. Other Output Devices

A. Laser printers (TM 3)

1. Similar in some ways to dot matrix printers

   a. Capable of printing in multiple fonts and font grids

   b. Can perform all functions of a dot matrix with better quality

2. Similar in some ways to a standard copying machines

   a. Many models have same mechanics as photocopier

   b. Contains toner cartridge

   c. Is a "copier with brains"

3. Advantages

a. High quality output - almost as good as typesetting or offset printing

b. Speed - completed print-out is usually ready in less than 10 seconds.

4. Disadvantages

a. Cost - $3,000 to $4,000

b. Size - produces only 8-1/2" x 11" or 8-1/2" x 17" output

c. Output is rarely to scale.

B. Electrostatic plotters

1. Basically a giant copy machine

2. Produces large output to scale

3. Advantages

a. Speed reproduces drawings in less than one minute

b. Output is usually to scale.

c. High quality output

4. Disadvantages

a. Cost - $5,000 to $6,000

b. Output is usually not reproducible.

IV. Summary

A. Types of printers

B. Types of plotters

C. Other output devices

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT XI : OUTPUT DEVICES

INTERACTION ITEMS: (Review Items)

1. What is one of the limitations of a dot matrix printer?

CLASSROOM, LABORATORY, SHOP, OR OTHER ACTIVITIES:

1. Students should practice producing hard copies on the classroom graphic output devices.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT XI : OUTPUT DEVICES

EVALUATION ITEMS:

1. List the two basic types of printers.

   a.

   b.

2. List two advantages and two disadvantages of using printers with CAD.

   Advantages

   a.

   b.

   Disadvantages

   a.

   b.

3. List the two basic types of plotters.

   a.

   b.

4. List two advantages and two disadvantages of using plotters with CAD.

   Advantages

   a.

   b.

   Disadvantages

   a.

   b.

5. List two advantages and two disadvantages of laser printers.

Advantages

a.

b.

Disadvantages

a.

b.

6. List two advantages and two disadvantages of electrostatic plotters.

Advantages

a.

b.

Disadvantages

a.

b.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT XI : OUTPUT DEVICES

ANSWERS TO EVALUATION ITEMS:

1. a. Daisy wheel (letter quality)
   b. Dot matrix or dot addressable

2. Advantages: the student may list any two of the following

   a. Speed-drawings can be printed quickly.
   b. Low cost - usually under $1,000
   c. Versatility - can be used for alpha as well as graphic output

   Disadvantages

   a. Size - drawings are rarely printed to scale
   b. Low quality of output

3. a. Flat bed plotter
   b. drum plotter

4. Advantages

   a. Accuracy - drawings usually are reproduced to scale
   b. Reproducibility - drawings can be plotted on traditional materials and blueprinted normally

   Disadvantages: the student may list any two of the following

   a. Cost - Some plotters cost as much as $25,000
   b. Size - drawing size is limited to size of plotter
   c. Speed - plotters are slow; a complex drawing may require several hours to reproduce.

5. Advantages

   a. High quality output - almost as good as typesetting or offset printeding
   b. Speed - print-out is complete in as little as 10 seconds.

   Disadvantages: the student may list any two of the following

   a. Cost - $3,000 to $4,000
   b. Size - limited to 8-1/2" x 11" or 8-1/2" x 17"
   c. Output is rarely to scale.

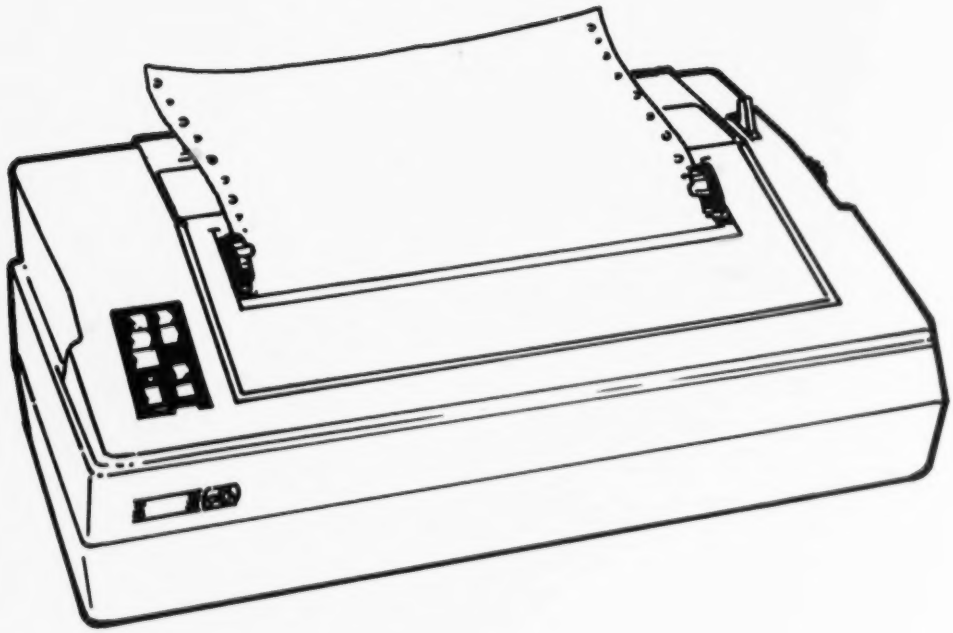
6. Advantages: the student may list any two of the following

   a. Speed - reproduces drawings in less than one minute
   b. Output is usually to scale.
   c. High quality output

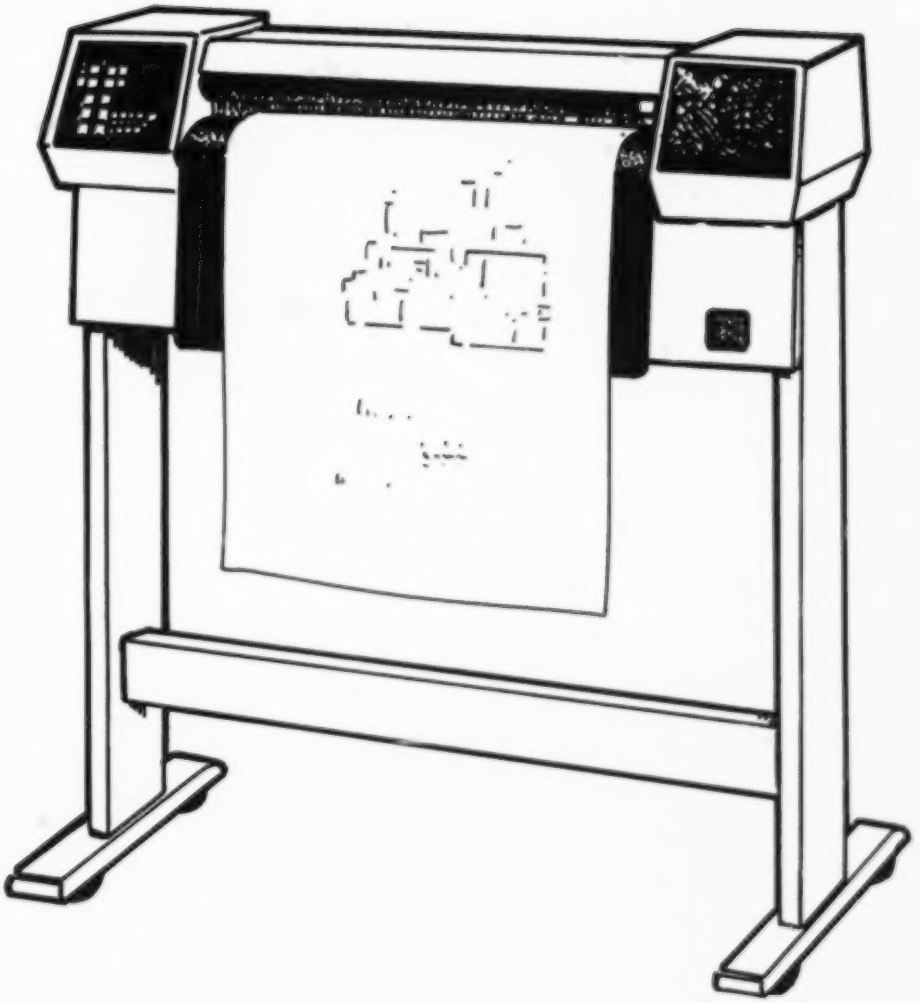
   Disadvantages

   a. Cost is high, usually $5,000 to $6,000.
   b. Output usually is not reproducible.

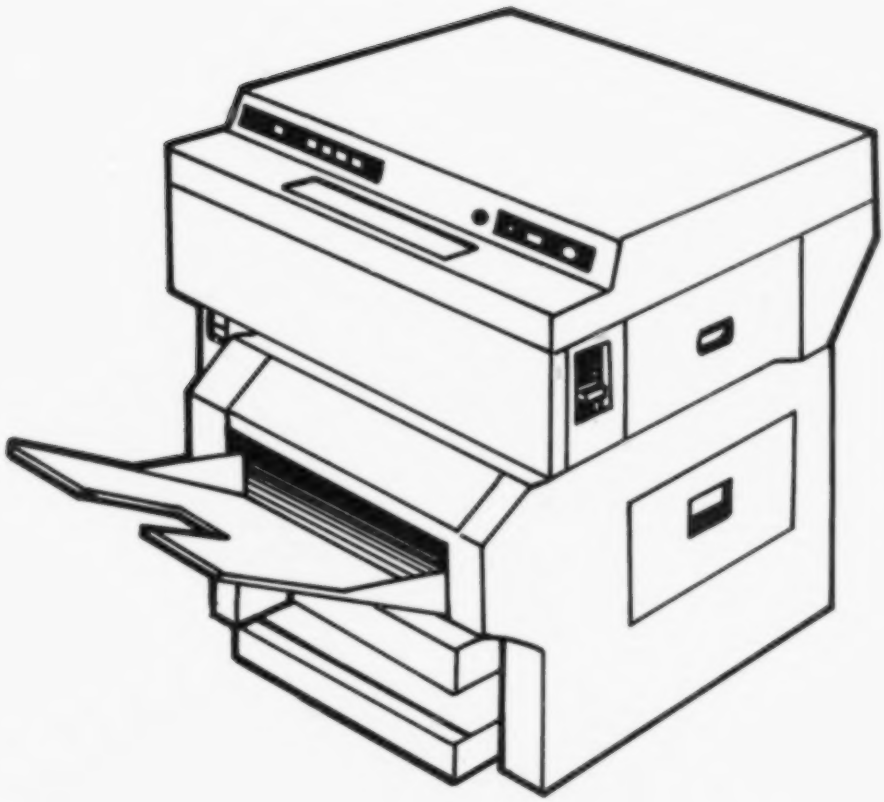
# Printer



# Plotter



# Laser Printer



LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT XII : EXITING A CAD SYSTEM

SCOPE OF UNIT:

Upon completion of this unit, the student will be able to end a CAD session and shut down the equipment.

INFORMATION TOPIC: OR DEMONSTRATION: X

LOGGING OFF A CAD SYSTEM
(Lesson Title)

LESSON OBJECTIVE - THE STUDENT WILL BE ABLE TO:

1. Log off and shut down the classroom CAD system according to steps of procedure.

SUPPLEMENTARY TEACHING/LEARNING ITEMS:

INFORMATIONAL ASSIGNMENT: (Student)

The student should read any machine specific information pertaining to the log off procedure.

REFERENCES: (Instructor's Additional Information)

See bibliography.

See glossary.

INTRODUCTION:

After a drawing session is completed on a CAD system, the operator must ask permission to leave and shut the equipment off. This procedure is called "logging off." During log off, drawings are saved, disks are stored, and the equipment is turned off.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT XII: EXITING A CAD SYSTEM

STEPS OF PROCEDURE:

(NOTE: This procedure reflects the steps needed to log off a MATC-CAD emulating system. The instructor should modify the outline to reflect the steps necessary to log off the classroom CAD system.)

I. Log Off System

A. Store all drawings in permanent storage.

1. Store on disk.

2. Some systems automatically store drawings upon leaving system.

3. Some systems store drawings in small pieces during the course of normal work.

B. At the "#" prompt, type the command "log off."

1. The system will begin the log off procedure.

2. Save all work before entering the command.

II. Power Down System (II-1)

A. Remove all floppy disks from drive.

1. Store them properly.

2. Upright, in a protective sleeve

B. Turn CPU off.

C. Turn off all peripheral devices. (II-2)

1. Plotter

2. Printer

3. Monitor

4. Other equipment

III. Summary and Conclusion

A. Log off system

B. Power down system

This procedure varies from system to system. Before leaving a system, however, you must log off. If the log off procedure is not properly executed, the next person using the system may disturb or even destroy any work in progress. The procedure is not difficult but must be done exactly right.

Once the operator has logged off the CAD and turned the power system off, the job is complete. This does not mean the job of learning CAD is complete, however. The operator must continue to practice, gaining speed and efficiency in CAD-oriented tasks. Skills not used are quickly lost and CAD operation is no exception.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT XII : EXITING A CAD SYSTEM

INTERACTION ITEMS: (Review Items)

1. How does "log off" differ from "power-down?"

2. What gets turned off first?

CLASSROOM, LABORATORY, SHOP OR OTHER ACTIVITIES:

1. The student should practice the log off procedure under instructor's supervision.

LESSON PLAN: 1

COURSE TITLE: COMPUTER AIDED DRAFTING

UNIT XII : EXITING A CAD SYSTEM

EVALUATION ITEMS:

| DID THE STUDENT: | YES | NO |
|---|---|---|
| I. Log off system. | | |
| A. Store all drawings in permanent storage. | | |
| B. Type in log off command. | | |
| II. Power down system. | | |
| A. Remove floppy disks from drive. | | |
| B. Store disks properly. | | |
| C. Turn CPU off. | | |
| D. Turn off peripheral devices. | | |
| 1. Plotter | | |
| 2. Printer | | |
| 3. Monitor | | |
| 4. Other equipment | | |

The student has satisfactorily completed the procedure "LOGGING OFF A CAD SYSTEM" according to the steps of procedure.

_____

Instructor's Signature
(Verifying Satisfactory Completion)

_____

Date

# APPENDIX A

## USING DOS*

Most of the following information deals with using DOS to get a hard disk system up and running with your software loaded on it. Some of the programs deal with AUTOCAD but the principles are the same for other systems. This appendix is intended to supplement your DOS and computer manuals and provides information pertaining to:

1. Disk drive designation
2. Function keys
3. Directory commands
4. Format floppy disks
5. Prepare and format a hard disk
6. Make a directory
7. Change a directory
8. Copy a disk
9. Use of batch files
10. ED line
11. Create and use a main menu
12. Sample batch files

## DOS COMMANDS

DISK DRIVE DESIGNATION:

When you are in the disk operating system you may see these prompts A> or C> or B>. DOS can be used to copy files, disks, back up files or disks, format disks, or find out what is on a disk.

FUNCTION KEYS:

F 1 Will repeat last command letter by letter
F 3 Will repeat last command

TO REBOOT (READ DRIVE A):

Hold down three keys at the same time - CTRL, ALT, DEL.

DIRECTORY:

DIR command will give you a listing of the files you have on a disk or directory.
DIR/P will give one screen at a time. Then strike ENTER for next screen.
DIR/W will give you a directory that is wide.

TO FORMAT YOUR PARTS DISK:

Put DOS in drive A, turn on the computer. When the drive stops put your blank disk in drive B. Type the following: FORMAT B: (to format a system disk: FORMAT B:/S).

TO COPY A DISK:

The new disk needs to be formatted first. Start with DOS in drive A. Put the disk you want to copy in drive A and the destination disk in drive B. Type: COPY *.* B: (RET).

TO DELETE FILES (DRAWINGS) FROM YOUR PARTS DISK:

Type DEL space (drawing name).(extension) then press ENTER to delete the drawing named part1. The command would look like this: A>DEL PART1.DWG.

## PREPARING A HARD DISK

Before a hard or fixed disk can be used, it must be prepared and formatted. This is usually done by the company supplying your computer, but you should be familiar with the procedure just in case you have to go in it alone or redo it after everything has been lost or the hard disk filled to capacity by accident.

This procedure is covered very thoroughly in your DOS manual and you should use that as your guide. This section is only an overview of the procedure.

With the DOS diskette is drive A and the DOS prompt ( A> ) on the screen, type:

```
FDISK
```

and press enter. The following screen will appear. The exact format will differ for different machines, but all will give options such as:

1. Create MS-DOS Partition
2. Change Active Partition
3. Delete MS-DOS Partition
4. Display Partition Information

Since most systems will only be operating in MS-DOS, we will select option #1 from the menu. Type Y (for yes) when asked if you want to use the entire fixed disk for MS-DOS and press Return. When partitioning is complete the partition size will be displayed. You should then return to DOS for formatting.

The formatting may take a while. On some older systems, this procedure may take as long as two or three hours. Usually a screen prompt will give you an indication of how long to expect. On newer systems formatting takes only five to fifteen minutes.

With the A> showing and the DOS diskette in drive A, type:

```
FORMAT C:/S
```

this will format the hard disk drive as drive C and place the DOS system file onto the root directory of the disk. This allows you to boot the machine from the hard disk.

To get the most efficient use from your hard disk, you need to organize it into subdivisions. The root directory can be visualized as the main or trunk directory out of which branches all other directories. You can store everything in the root directory, but this would become cumbersome in a very short time. The root directory is normally used only for the DOS system file, the main menu program, an AUTOEXEC program, and to list other directories that contain all other software and data.

You are now ready to create directories for your individual software. It's a good idea to put each software program into an individual directory. The name of the directory should give some idea of what program resides there. The name may be up to eight letters long. To create a directory we use the MD command. These letters stand for Make Directory. For example:

```
MD ACAD
```

creates a directory titled ACAD in which the instructor's program may be stored. DOS can be used as a directory title to store the instructor's format disk program which may be called from the main menu to format a student's disk.

After you have created the directories you need, you must save your programs to these directories. To do this, you need to be able to change the active directory from one to another. This is accomplished using the CD (change directory) command and looks like this:

```
CD\ACAD
```

Be sure to use the backslash or the command won't work. The active directory is now ACAD.

To copy AUTOCAD diskettes onto the hard disk you can either use the DISKCOPY command or the COPY command. I prefer the COPY command since it checks for errors in writing to the hard disk as it is copying. The DISKCOPY simply copies everything from one disk to the other, errors and all. To use the COPY command, with the diskette to be copied in drive A type:

```
COPY *.* C:
```

The * tells the computer to copy all programs with a title and an extension from drive A to the ACAD directory on drive C. If we wanted to copy only programs with a specific extension, say .BAS, we would type the command:

```
COPY *.BAS C:
```

Or, if we wanted to copy programs titled STUDENT.XXX, we would type the command:

```
COPY STUDENT.* C:
```

This is useful if you want to copy certain files or programs from the hard disk onto a student's personal floppy diskette. All you have to remember is to change drive designators to copy from the C drive to the A drive.

After all programs are copied into directories, all that's left to do is create a Main Menu program in the root directory and an AUTOEXEC.BAT program for start-up.

## USE OF BATCH FILES

The use of batch files for menus is one of the most useful tools for the personal computer. A batch file is any program which has the extension .BAT. For example, MENU.BAT is a menu batch file program which will display a menu selection list on the CRT screen. The following is such a menu program:

```
1:   ECHO OFF
2:   CLS
3:   ECHO          *****N S HILLYARD AVTS*****
4:   ECHO                    MAIN MENU
5:   ECHO              PROGRAM              TYPE IN
6:   ECHO              AUTOCAD                AC
7:   ECHO            VOLKSWRITER              VW
8:   ECHO         FORMAT STUDENT DISK         FD
9:   ECHO               QUIT                  QT
```

We will write the program using the EDLIN program from the DOS disk. We will assume that the program will be written to a hard disk designated as the C drive. The starting command will be: (After each line the Return or Enter key must be pressed)

```
EDLIN C:MENU.BAT
```

The screen will then display:
New File
*_____
Type 1I to start inserting text on line 1.

```
1:   ECHO OFF    TURNS THE SCREEN DISPLAY OFF AND ONLY
                 DISPLAYS TEXT AND NOT COMMANDS.

2:   CLS         CLEARS THE CRT SCREEN OF EVERYTHING.

3:   ECHO                *****N S HILLYARD AVTS*****
                 DISPLAYS THE TEXT:
                         *****N S HILLYARD AVTS*****
```

LINES 4 THROUGH 9 DISPLAY TEXT SHOWN AFTER ECHO.

When you have written all the lines of the program, hold the Ctrl key down and press the Break key. This will get you out of the automatic line numbering and return you to the * prompt. Type "E" to end the program editor.

The program is now saved on the hard disk and ready for use.

## MS-DOS

The disk operating system most encountered on today's personal computers is Microsoft MO-DOS. This is the disk operating system for the IBM-PC and compatibles. We will only cover a very few of the common commands. The disk operating system is very powerful and you should take the time to become familiar with all its commands. There are many computer aided learning programs, such as Learning MS-DOS from Microsoft, which do a more than adequate job.

## FORMAT

The format command prepares a diskette or hard disk drive to accept data. It sets up a file allocation table where it stores the file names and sector locations where the file data is stored. Care should be taken not to accidentally format the hard disk drive when you really wanted to format a floppy diskette. We have included a batch file program to prevent this problem from happening. When a diskette or hard disk is formatted all data is erased and lost; be careful with this command.

## DIR

The DIR command allows you to see what is stored on a hard disk or floppy disk. This is useful when you lose track of a file or just want to see what is there.

## CREATING AN AUTOEXEC.BAT FILE

The AUTOEXEC.BAT file is one of the most useful and least understood files on the PC. When the computer boots up, it looks for an AUTOEXEC.BAT file. If it finds one, it will automatically follow the commands contained there. You can size RAM disks, set printer configurations, and call up menu programs from such a file. We will use the COPY CON (copy console) feature to create our AUTOEXEC.BAT file. The sequence is as follows:

```
C> COPY CON C:AUTOEXEC.BAT
   MENU
    F6
```

The COPY CON tells the computer that we are going to create a program file from the keyboard console; the file will be stored on drive C. AUTOEXEC.BAT tells the computer that the batch file program name is AUTOEXEC. Each line created using COPY CON carries a different line number and can be edited using the EDLIN program. The simple program above loads the MENU.BAT file and displays the menu on the screen. The F6 command is obtained by

pressing the F6 function key and tells the computer that you are finished creating your program from the keyboard, to save it to the specified disk drive and exit to DOS.

More elaborate AUTOEXEC.BAT files may be created and are only limited by your imagination and capacity of your system, but this also applies to the entire computer system. Its power is only limited by the imagination of its user.

## BATCH FILES FROM THE MAIN MENU

We now must crete batch file programs for each item on the main menu. We do this the same way as we created the main menu program using the EDLIN line editor from DOS.

### AUTOCAD BATCH FILE PROGRAM

```
EDLIN C:AC.BAT
New File
*_____
1I
1:  CLS
2:  CD\ACAD
3:  ACAD
4:  CD\
5:  MENU
6:  CTRL BREAK
* E
```

Line 1: CLS clears the screen
Line 2: CD\ACAD changes the hard disk directory to the AutoCad directory
Line 3: ACAD automatically starts the AutoCad program
Line 4: CD\ changes to the root directory on the hard disk when the AutoCad program is exited
Line 5: MENU brings up the main menu to the screen again
Line 6: Ends the program

### VOLKSWRITER BATCH FILE PROGRAM

```
EDLIN C:VW.BAT
New File
*_____
1I
1:   CLS
2:   CD|VW
3:   VW
4:   CD\
5:   MENU
6:   CTRL BREAK
* E
```

As can be seen, this program is identical to the AutoCad program except for the directory call and the VW command to start Volkswriter.

## FORMAT STUDENT DISK

To prevent accidental reformatting of the hard disk, it is a good idea to include a format batch program that only formats a floppy disk in drive A. This can be done by hiding the format command in a hard disk directory and calling it with a batch program.

```
EDLIN C:FD.BAT
New File
*_____
1I
1:    CLS
2:    CD\DOS
3:    FORMAT A:/S
4:    CD\
5:    MENU
6:    CTRL BREAK
* E
```

This will prompt the student to put a new disk in drive A and press any key when ready. When formatting is complete, the program will ask if the user wants to format another disk. When finished, the program will return to the main menu.

## QUIT BATCH FILE PROGRAM

Most hard disks now have an automatic parking feature which places the head over an unused portion of the disk. However, some systems require you to perform this function manually. If this is the case, your DOS disk will have a program named SHIP or PARK or something similar. We will use PARK for this example.

```
EDLIN C:QT.BAT
New File
*_____
1I
1:    ECHO OFF
2:    CLS
3:    PARK
4:    ECHO       WHEN THE HARD DISK DRIVE LIGHT GOES OUT
5:    ECHO       YOU MAY SAFELY SHUT DOWN THE SYSTEM.
6:    ECHO       THE KEYBOARD AND ALL SYSTEMS WILL BE
7:    ECHO       LOCKED.  IF YOU WANT TO RESTART, YOU
8:    ECHO       MUST TURN OFF THE POWER FOR 30 SECONDS
9:    ECHO       AND THEN RESTART.
10:   ECHO       CTRL BREAD
* E
```

## COPYING OR DUPLICATING A FLOPPY

Most computer systems today have only one floppy disk drive and a hard drive. This causes problems for users who are not all that familiar with the DOS commands. A batch file can be written as follows to accomplish the task automatically.

```
EDLIN C:DUP.BAT
* 1I
1:    ECHO OFF
2:    CLS
3:    CD\TEMP
4:    ECHO     PLACE DISKETTE TO BE DUPLICATED IN DRIVE A
5:    PAUSE
6:    COPY A:*.*
7:    ECHO     REPLACE DISKETTE IN DRIVE A WITH A BLANK
8:    ECHO     FORMATTED DISKETTE
9:    PAUSE
10:   COPY *.* A:
11:   ERASE *.*
12:   REM THE COMPUTER WILL ASK IF YOU ARE SURE Y/N
13:   REM TYPE Y AND THE TEMP DIRECTORY WILL BE ERASED
14:   CTRL BREAK
* E
```

This batch program will only work if you have a directory named TEMP on your hard disk. Also, the TEMP directory must be empty before you start the duplicating process. If the directory contains files, they will be copied onto the new diskette along with the files desired. We have introduced a new command (PAUSE) in the batch program. This command stops the program and waits for the requested action to be performed before continuing. It automatically adds the prompt "strike any key to continue."

This batch program should be placed on the main menu as well.

## EDITING THE MAIN MENU BATCH PROGRAM

Suppose you have purchased a data base program and wish to add this option to the main menu program. This can be done using the EDLIN program from the DOS disk just as if you were creating the program from scratch with a few command changes.

```
EDLIN C:MENU.BAT
*     (You won't see the New File line since the program
      is already on the disk)
*L    (This lists the program as it is now written)
```

Add your data base program option between lines 8 and 9. To do this we give the command "9I" for insert a line before line 9. You then type in our new line. All the line numbers after the

new line will be automatically renumbered. To exit the insert mode, press Ctrl-Break.

The program sequence would look as follows:

```
EDLIN C:MENU.BAT
*
*L
1:    ECHO OFF
2:    CLS
3:    ECHO       *****N S HILLYARD ATVS*****
4:    ECHO                  MAIN MENU
5:    ECHO          PROGRAM              TYPE IN
6:    ECHO          AUTOCAD                 AC
7:    ECHO        VOLKSWRITER               VW
8:    ECHO     FORMAT STUDENT DISK          FD
9:    ECHO            QUIT                  QT
9I
9:    *ECHO       DATA BASE                 DB
10    *Ctrl-Break
```

The program will look exactly as above except line 9 will read:

```
9:    ECHO         DATA BASE                DB
10:   ECHO            QUIT                  QT
* E   (Ends and saves program)
```

*This handout was prepared by Milton Moore, N.S. Hillyard Area Vocational Technical School, St. Joseph and Ray Wheeler, President of A-R Engineering, Inc., St. Joseph.

## APPENDIX B

## AUTOCAD*

AUTOCAD 2.5 or later will run only on a hard disk machine. Versions 2.18 and earlier will run on a dual floppy drive machine.

**START-UP PROCEDURE**

### HARD DISK SYSTEMS

Hard disk machines should work from a main menu system allowing the user to select different software programs (See Appendix A). Turn the machine on with no floppy disk in drive A; this forces the machine to boot off the hard drive (C). Select AUTOCAD from the main menu and place your parts floppy disk in drive A. You should now have the main menu on the screen.

### FLOPPY DISK SYSTEMS

For dual floppy drive machines put the execute disk in drive A, the OVL disk in drive B, and turn on the system. The computer will boot up and the message "Cannot find overlay" will appear on the screen. Type "B:", "Return", and the machine will then complete its boot-up procedure. Remove the floppy from the A drive and replace it with your parts floppy disk. For a dual drive system, the parts floppy must have the support files on it. You should now have the main menu on the screen.

**MAIN MENU**

0. EXIT AUTOCAD
1. BEGIN A NEW DRAWING
2. EDIT AN EXISTING DRAWING
3. PLOT A DRAWING
4. PRINTER PLOT A DRAWING
5. CONFIGURE AUTOCAD
6. FILE UTILITIES
7. COMPILE SHAPE/FONT DESCRIPTION FILE
8. CONVERT OLD DRAWING FILE

A menu selection is made by simply typing in the number of the desired task and pressing the enter key or space bar. This results in a short dialogue prompting you for additional information. If you make a mistake during the dialogue, press "Ctrl C" to return to the "Enter selection" prompt.

You will only be using the first three items on the menu until you become more familiar with AUTOCAD. Plotting a drawing is usually done from within the drawing editor for the first few months.

**TASK 0 - EXIT AUTOCAD**

When you select this menu task, AUTOCAD terminates and returns you to the main DOS menu or the DOS system if you are not using a main menu. On dual floppy systems, remove the parts disk from drive A and replace with the executive disk and press return.

**TASK 1 - BEGIN A NEW DRAWING**

Selecting this task starts the drawing process. You will be asked to "Enter name of drawing." The name may be up to eight characters long and must start with a letter. If your drawing is to be stored on a floppy in drive A, type A: before the name. For example: "A:PROBLEM1" would store the drawing "PROBLEM1" on the A drive.

The best advice for naming drawing files is to keep them as simple and descriptive as possible. You'll be surprised how quickly you forget the names of your drawings.

**TASK 2 - EDIT AN EXISTING DRAWING**

To make changes and additions, plot, or just to display an existing drawing, select this task. You will be asked for the drawing name just as in Task 1. If no drawing is found with the specified name, AUTOCAD will display the message **NO DRAWING WITH THIS NAME IS ON FILE**. Be sure to designate which drive the drawing is on.

If the drawing name is valid, the drawing will be displayed on the monitor and the drawing editor menu will display down the right side of the screen.

**FUNCTION KEYS**

The function keys are used to toggle certain popular command setting on and off:

F1 Text mode (help) or back to the drawing editor
F6 Coordinates on/off
F7 Grid on/off
F8 Ortho on/off
F9 Snap on/off
F10 Graphic tablet on/off

**MOUSE OR PUCK BUTTONS**

Left or #1 pick
Center or #2 repeat last command
Right or #3 redraw

On four-button pucks, only three buttons work. Usually button #4 is the same as button #3. On AUTOCAD 2.52 and later versions, the redraw button brings up the redraw menu on the drawing editor.

**DEFAULT DRAWING**

When you start a new drawing, AUTOCAD brings up a default drawing which sets up some basic parameters. This drawing is usually called ACAD unless another drawing is specified in the configuration setup. You'll learn how to setup default drawings when you become more proficient with AUTOCAD.

**DRAWING EDITOR MENU**

| VERSION 2.18 | VERSIONS 2.5 & 2.6 |
|---|---|
| BLOCKS | ***** |
| DIM: | SETUP |
| DISPLAY | BLOCKS |
| DRAW | DIM: |
| EDIT | DISPLAY |
| HATCH: | DRAW |
| INQUIRY | EDIT |
| LAYERS | INQUIRY |
| MODES | LAYER: |
| PLOT | SETTINGS |
| UTILITY | PLOT |
| | UTILITY |
| | 3D |
| | SAVE: |

You will notice some difference in the root layout from one version to another, but the commands are the same. Each item on the root will in turn bring up a sub-menu with an expanded command list. AUTOCAD uses this method to conserve space on the drawing editor screen. Most of the commands are self-explanatory. Refer to the AUTOCAD manual or your AUTOCAD textbook for explanations of each drawing command.

**LAYERS**

AUTOCAD allows you to set up an infinite number of layers within a drawing. You can use layers for different linetypes such as one for center lines, one for hidden lines, etc. In more complex drawings, different components may be placed on different layers. For example, when drawing an architectural layout you might place the walls on a layer named "walls," the electrical schematic on a layer named "electrical," and the plumbing layout on a layer called "plumbing." You can then turn each individual layer on or off. When a layer is turned off or "frozen," any lines or entities on that layer will not be displayed on the monitor. This is very helpful when you need to see just how component parts are going to fit together. It also allows you to plot certain information such as the electrical schematic by certain information such as the electrical schematic by itself without interference of overlapping lines or information. It is also advisable to put your dimensioning and text on separate layers. When drawing, the dimension and text layers can be frozen and the drawing will regenerate approximately four times faster, saving a great deal of time.

**COLORS**

If you have a color monitor, the use of color to distinguish different layers is most helpful. AUTOCAD allows you to specify up to 7 basic colors. Some video cards will allow up to 256. the basic colors are:

1 Red 2 Yellow 3 Green 4 Cyan 5 Blue 6 Magenta 7 White

Even if you don't have a color monitor, you can plot in color by specifying different colors for different layers. When plotting, AUTOCAD will stop and prompt you to change pen colors. This is also an easy way to plot different line weights within a drawing.

**LINETYPES**

AUTOCAD has nine standard linetypes. Examples of each are shown in your manual. Custom linetype may be created within AUTOCAD, but this takes a fair knowledge of programming and is beyond the scope of this text. The standard linetypes are:

Continuous
Dashed
Hidden
Center
Phantom
Dot
Dashdot
Border
Divide

**LTSCALE**

This sets the dash specifications in a linetype. Since units may change from drawing to drawing the LTscale can be adjusted to suit.

**THE DRAWING EDITOR**

After entering the drawing editor either from task 1 or task 2, you are now ready to start drawing. Before doing so though, we need to do some basic or initial housekeeping. Just as when drawing on paper, we need to determine what our drawing sizes will be, what units we will be drawing in, the increment of snap, the size of our grid, etc.

Any item on the menu may be selected two different ways. It can be typed in from the keyboard, or it may be chosen from the menu area on the right side of the drawing editor screen with the pointing device. It is generally much faster to type the command from the keyboard than to choose it from the menu. This is because you have to go from the root menu to the next more specific menu to the more specific etc. For those not as familiar with the AUTOCAD commands, the menu is the way to go.

If you are using a graphics tablet, you may also have customized overlays that can be placed on the tablet drawing area. These are very helpful in speeding up command selection.

**UNITS**

The four types of units utilized by AUTOCAD are:

| | |
|---|---|
| Scientific | (2.175E+01) |
| Engineering | (1' 9.75") |
| Decimal | (21.75) |
| Architectural | (1' 9 3/4") |

On version 2.6 metric units are also included.

**LIMITS**

Limits allow you to set up the drawing size. AUTOCAD will allow any size drawing to be used. Keep in mind though, that the size of the monitor is the limiting case. Very large drawings produce very small entities or drawing elements. In any case, the drawing limits are set in inches even for architectural units.

AUTOCAD will prompt for the lower left corner <0.0>. Some people like to place the lower left corner at <-1, 1> so that <0,0> is visible on the screen. In any case, type in the "X" components first, then a comma, then the "Y" component followed by "Return." AUTOCAD will then ask for the upper right corner. Input this value in the same manner as the lower left corner. If you want to use the values displayed in brackets, < > simply press "Return" to accept the setting.

**GRID, SNAP, AND AXIS**

The grid command places a drawing grid on the screen. This is similar to drawing on rules or quadrangle paper. The grid marks will not be plotted on the final drawing. The grid spacing can be set by typing "grid" and then following the screen prompts. The grid may be toggled on/off using the F7 key.

Snap allows the cursor to move or jump in specified increments. Like the grid command, snap is set by typing "snap" and following the screen prompts. The snap function may be toggled on/off using the F9 key.

The axis command placed tick marks around the bottom and right side of the graphics screen. These can also be set using the same technique as for grid and snap.

**SAVE**

Saves a drawing to the disk file and returns you to the drawing editor. AUTOCAD asks if this is the file name you want to use and gives you the drawing name you gave AUTOCAD when you started. Press return to save the drawing.

**END**

Saves the drawing to disk, terminates the drawing, and returns you to the main menu. It does not prompt for the drawing name.

**QUIT**

Exits the drawing editor and does not save the drawing. AUTOCAD prompts if you are sure you want to exit without saving. You just enter "Y" to exit or "N" to return to the drawing editor.

**GETTING AROUND THE DRAWING EDITOR**

Putting actual lines on the screen is accomplished in two ways. One, by using the pointing device and two by using the relative coordinate method more commonly called "keyboarding." The speediest method is of course with the pointing device. The most accurate is by keyboarding. Keyboarding is started with the "@" and is followed by a set of coordinates or by a line length. For example, 3,4 < > @4,3 <> means to start a line at X=3 & Y=4 and draw the line over 4 X units and up 3 Y units. 3,4 <> @2.5<90 < > means to start a line at X=3 & Y=4 and draw the line 2.5 units long at an angle of $90^{o}$. This latter method gives very accurate results.

**ZOOM**

One of the most powerful features of AUTOCAD is the zoom command. It allows you to work on very small areas of the drawing by enlarging or zooming them up to full screen size. The magnification can be as much as a trillion to one. The more popular zoom commands are:

Zoom all - zooms to the drawing limits
Zoom extents - fills the screen with the total drawing
Zoom window - enlarges the area of a window you define; AUTOCAD asks for the corners of the window
Zoom previous - returns to the prior view

**PAN**

Pan is somewhat of a confusing term. What it means is to move around the drawing without changing any of the geometry or the zoom magnification. Pan is used mostly with larger drawing sizes where you are zoomed up on a small area to draw details or edit. It is then easier to pan or move to adjacent areas of the drawing without having to do a zoom all to get back to the drawing limits. The major problem with pan is that you can become lost in the drawing while panning around. This happens especially when you have large areas of the drawing which are blank or have no entities. Version 2.6 allows you to pan while drawing lines, circles, etc. This is called a transparent pan and can be a very powerful tool with experience and practice.

**OBJECT SNAP**

This command is called OSNAP on the AUTOCAD menu. It allows you to set the mode to snap to specific points of existing entities such as endpoint, midpoint, intersection, or perpendicular to a line. OSNAP can tell AUTOCAD to snap to the center of a circle, to a specified quadrant, or tangent to lines or circles. These commands are self-explanatory from the root menu.

**APERTUR**

This command adjusts the size of the square or box used with the crosshairs when in the OSNAP mode.

**BLOCKS**

AUTOCAD uses the block command to store away drawings of components parts which may be used over and over again in other drawings. They may be inserted in any location, rotated and scaled up or down to fit the scale of the present drawing. This is one of the most powerful features of AUTOCAD or any CAD software. Blocks can be inserted either as a single entity. This is accomplished by issuing the command block < > insert < > (block name). When you insert a block in this manner, you can't edit or change anything within the block. AUTOCAD treats the whole block as if it were one entity. If you will need to edit an inserted block, simply put an "*" before the block name (*block name).

The WBLOCK command stores a block away in a master file. It then can be used in any drawing.

**ARRAY**

Array allows you to make multiple copies of an object or objects in a geometric pattern. This pattern can either be rectangular or circular. The rectangular array asks for the number of rows and columns and the spacing between rows and columns. Always remember that rows are across (horizontal) and columns are vertical. The circular array is called a polar array in versions 2.5 and later.

**CHANGE**

The change command allows you to change the layer or properties of entities. You can change the linetype of a line from continuous to a centerline, entity color, etc.

## DIMENSIONING

### DIMENSION VARIABLES

We will only mention some of the more commonly used commands.

DIMSCALE - Overall scale factor
DIMASZ - Arrow size
DIMCEN - If set at -.1 will give centerlines instead of centermarks
DIMTXT - Text size
DIMLI - Distance between dimensions
DIMEXE - Extension above dimension line
DIMTP - Plus tolerance
DIMTM - Minus tolerance
DIMTSZ - Tick size
DIMEXO - Extension line origin offset

## PRINTING AND PLOTTING

AUTOCAD has the capability to output to most popular printers and plotters. The capabilities of the hardware vary greatly and will not be discussed.

### PRINTER PLOT

The printer will give you a reasonably good print of the drawing. They are somewhat restricted because of the size of the printers themselves. Drawing sizes up to 11" x 13.9" are possible with version 2.6.

### PLOTTER OUTPUT

This is the chosen method of output in 90% of the cases. Plotters up to 36" x 48" are available in a variety of price ranges. This method gives the most professional-looking drawing. AUTOCAD drawings may be automatically scaled to fit the plotter size. This capability allows drawings to be drawn "full scale" and then scaled to fit the plotter paper available.

### PRINTER COMMAND OUTPUT

AUTOCAD has a feature which will print each command in sequence. This can be helpful for instructors and students in tracing the sequence of events during a drawing session. To enable this feature type a "Ctrl Q." To disable the feature, type another "Ctrl Q."

This appendix only covers a small fraction of the commands and features of AUTOCAD. The power and scope of AUTOCAD is beyond the capabilities of a few pages or a quick glance. When all else fails, read the AUTOCAD manual. If this fails, consult your AUTOCAD dealer. He will be glad to help.

*This handout was prepared by Milton Moore, N.S. Hillyard Area Vocational Technical School, St. Joseph and Ray Wheeler, President of A-R Engineering Inc., St. Joseph.

## APPENDIX C

## MATC CAD*

NOTE: MATC has a version for an Apple or IBM. Most of the following information is for the Apple version.

**TO GET STARTED**

1. Make sure the cap lock is on. MATC CAD will not respond to lower case letters.

2. Put program disk in drive #1 or A.

3. Put data disk in drive #2 or B.

4. Turn on the computer and monitor or reboot the system.

5. Enter date (if date is correct hit return).

6. Type either O, A, J, K, L, M, OR ? (A for a machine with an Apple graphics tablet, J for a computer with a joy stick, K for a Kurta graphics tablet 8.5 x 11, L for a Kurta graphic table 12 x 12, M for a mouse, and ? for a display of input devices). On the IBM version this is done in the configuration program.

**FROM A>: YOU HAVE THE FOLLOWING CHOICES**

1. CADDS - To work on a drawing or start a new one, type CADDS then return.

   a. To start a new drawing--type N

   b. To work on an old drawing--type O

   c. Type part name

      (1) Start with a letter
      (2) Maximum length is seven letter or numbers
      (3) Keep it simple (PROB10)
      (4) No spaces

2. REC - Recover a drawing if the computer locks up or a power failure occurs.

3. UTIL - To get to file utilities (Apple version):

   a. Format parts disk

      (1) When the monitor shows a> type UTIL (Apple version) with IBM use DOS.
      (2) Type F then return.

(3) Insert disk to be formatted in drive #2. If there is data on it, it will be erased. A disk has to be formatted before it can be used.

b. Krunch diskette - eliminates nonusable space after several drawing have been put on a disk

c. Transfer files - is used to keep a second or third coy of the work

d. Rename files - change the name to better explain the drawing

e. Erase files - to make room on the disk for more drawings

f. List files - to tell you what is on your disk or to let you know how it is spelled

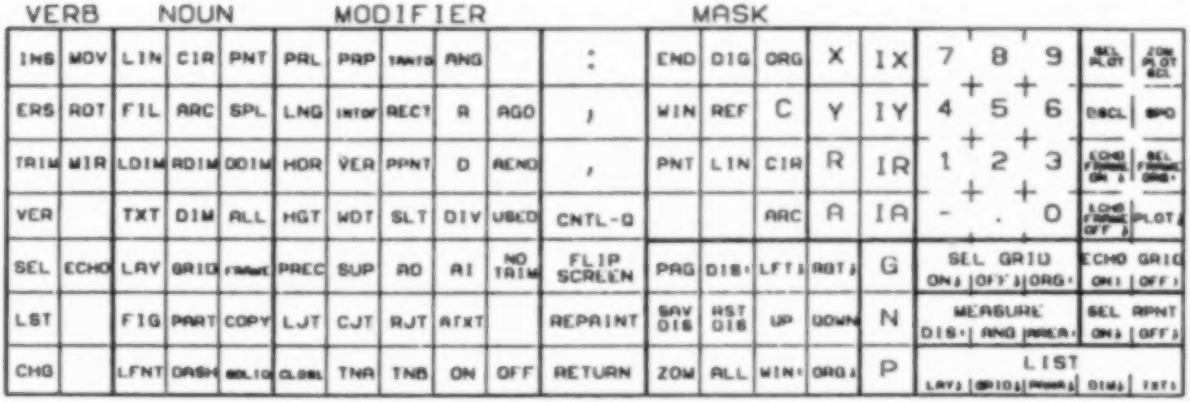
g. To get out of file utilities - quit and go back to drawing

**MENUS**

1. To get to graphics tablet menu type RST KEY

2. Menu at bottom of screen SEL PRO (this is an off and on switch)

3. RST key is used to activate the tablet menu.


VERB
NOUN
MODIFIER
MASK
INS MOV LIN CIR PNT PRL PRP TANTO ANG : END DIG ORG X IX 7 8 9
ERS ROT FIL ARC SPL LNG INTOF RECT R AGO , WIN REF C Y IY 4 5 6
TRIM MIR LDIM RDIM ODIM HOR VER PPNT D AEND , PNT LIN CIR R IR 1 2 3
VER TXT DIM ALL HGT WDT SLT DIV USED CNTL-Q ARC A IA - . 0
SEL ECHO LAY GRID PREC SUP AD AI NO TRIM FLIP SCREEN PAG DIS LFT RGT G SEL GRID ON OFF ORG
LST FIG PART COPY LJT CJT RJT ATXT REPAINT SAV DIS RST DIS UP DOWN N MEASURE DIS ANG AREA
CHG LFNT DASH CLOSEL TNA TNB ON OFF RETURN ZOM ALL WIN ORG P LIST LAY GRID DIMS TXT
SEL PLOT
ECHO ON
GRID OFF
SEL RPNT ON OFF

COPY A DISK (APPLE)

1. Put DOS 3.3 system master in drive #1.
2. Type RUN COPYA (No space between COPY and A).
3. Hit return four times. (The disk you want a copy of should be in drive #1 and the blank disk or the one with data you do not want any more should be in drive #2.) This will format the disk in drive #2.
4. Read the screen to continue.

TO QUIT

1. Type EXI (stands for exit).
2. Type F to save your drawing.
3. Type D if you do not want to save the drawing.
4. Type G (this will let you go to UTIL or QUIT).
5. Type LOGOUT.
6. Take out your disks before turning off the computer.

TO SAVE YOUR DRAWINGS

1. Type or digitize FIL (return).
2. Type F (return).
3. Then type the part name (you have a chance to change the name if you want.)
4. A (return) gives you the old name.
5. It is wise to save a drawing every 15 minutes and every other time use a different name.

TO SET UP A DRAWING

1. ECH GRD on or off - ECH GRD on allows you to see the grid on the screen. To see it type RPN (return).
2. SEL GRD on or off - this is the same as snap. The cursor will jump to the grid specified.
3. SEL GRD Gn (return) - this lets you change grid size.
   a. n is the number representing grid size (it may be a decimal).
   b. Type or digitize RPN and (return).

c. Sometimes you want a small snap, for example, 125 and a larger grid. The commands to get this are: SEL GRD G.5 (return) RPN (return) SEL GRD G.125 (return). This lets it jump on .125 increments while seeing .5 grid.

4. Layers - layers are numbered 0-255. You may mix line types in each layer.

5. Text height - the default is .156; to change--SEL TXT HGTn (return).

6. Number of decimal places - the default is 3; to change SEL PREn. n may equal 0-4.

7. Line type - the default is solid; to get dashed SEL DAS (return).

**DRAWING COMMANDS**

1. INS LIN - draws a line

2. INS LIN VER - draws a vertical line

3. INS LIN HOR - draws a horizontal line

4. INS LIN PRLn - draws a line parallel to an existing line at a specified distance (n). This is used in orthographic projection just like a triangle or T-square.

5. INS CIR - many combinations are possible; the origin is at 3 o'clock and is formed in counter clockwise direction.

6. INS ARC - also has many combinations; it is formed counter clockwise.

7. INS SPL - creates a smooth continuous curve.

8. ESC - gets you out of a command.

**SCREEN CONTROL**

1. RPN (RETURN) - is a redraw command; it redraws the screen

2. ZOOM ALL (RETURN) - fills the screen with the part

3. ZOOM ALL Pn (RETURN) - n% border around part

4. ZOOM ORG - this causes the original screen to reappear

5. ZOOM UP OR DWN - doubles or halves size the image

6. PAG DIS - shifts the image on the screen (PAN); does not change grid coordinates

7. SEL RPN OFF (RETURN) - turns off the text; lets it repaint faster

8. SEL RPN OFF (RETURN) - puts the text back on the screen at the next repaint

**EDITING**

1. ERS ALL (RETURN) - will erase the entire drawing!!!

2. ERS ALL - will erase any entity whether text, line, circle, arc, or other entity

3. TRIM LIN - will make a line shorter or longer

4. TRI LIN DIV - will make multiple lines out of one

5. TRI LIN INT DIV - causes a line to intersect with other lines and have more than one line; for example, the wall intersections on a house floor plan

6. INS FIL RO - this will trim two lines to a common vertex

7. INS CIR ARC - allows you to make a circle out of an arc

8. MIR MOV AND ROT - when used with copy can give you arrays

**TO CONSTRUCT CENTER LINES**

First draw a solid line where you want the center line to be. Set the grid small and zoom a window around where you want the line. Use the command TRI LIN DIV: then digitize the line where you want it to start, stop, start, stop, and so on until you have what you want.

**PARTS AND FIGURES**

1. INS FIG /PART NAME/ - enables you to combine drawings; a figure is treated as one entity and cannot be edited.

2. INS PART /PART NAME/ - is moved into your drawing as many entities and can be edited; example: a border and title block.

**PLOTTING**

1. ZOOM PLOT SCLn (RETURN) - changes the size of the drawing (including text) to make it either larger or smaller.

2. SEL PLOT DSCLn (RETURN) - changes the size of the drawing but not the text.

3. When using an Apple plotter you need to select the plotter speed 3 or 4.

4. SEL PRI ON OR OFF - turns the printer on or off while drawing; with the printer on, you can follow the commands you used.

**VERIFICATION**

1. This gives the geometry for the entity.

2. MEAS - you can find the angle, dist or area

**WHEN ALL ELSE FAILS READ THE MANUAL!!!**

*This handout was prepared by Milton Moore, N.S. Hillyard Area Vocational Technical School, St. Joseph.

## APPENDIX D

## CADKEY V1.41E*

1. A Config.Sys file must be created to include the following line:

   Files = 20

   Use Edlin as described in your DOS manual to create or edit this Config.Sys file.

2. When using CADKEY on a hard disk, from prompt ( C> ), invoke the A:CADinst routine. This routine automatically creates its own directory and subdirectories.

3. When using CADKEY V1.41E on a two floppy disk drive system, disk #1 must be in drive "A" and disk #2 must be in drive "B" for start up. After start up, remove disk #2 and install disk #3 in drive "B" for normal drafting.

4. After the program is installed it must be configured to correspond to your specific hardware. Simply run the Config routine and follow the prompts. In order to prevent major data loss, in case of power failure or system lockup, frequently invoke the control-F function to save the part to disk without exiting the program.

Some IBM PC compatibles, such as Epson and Leading Edge with built-in high resolution monochrome graphics, may not properly display images without first running a public domain software package called SIMCGA. This program "fools" CADKEY and allows proper displays in high resolution monochrome.

*This handout was prepared by David Baird, PAVTE Department, University of Missouri-Columbia.

Access time: (n.) The interval between the time a computer instruction is entered and the time the instruction is acted upon by the computer.

Acronym: (n.) A word formed from the beginning letter or letters of a phrase or compound term (e.g., CAD: Computer Aided Drafting).

Address: (n.) A number or title used by the computer to specify a location in memory.

ALT: (abbr.) The key label for the alternate key. (See ALTERNATE KEY.)

Alternate key: (n.) A key with a number of general purpose uses. Included are: 1) Use as a second set of function keys by some application programs; 2) Use to enter the ASCII character code directly from the keyboard; 3) Use in BASIC together with letters to enter BASIC commands.

ASCII: (acronym) American Standard Code of Information Interchange.

Application program: (n.) A program that applies the resources and power of a computer to a specific task (e.g., a computer aided drafting or word processing program). The output of an application program is people oriented. (See UTILITY PROGRAM, SYSTEM PROGRAM.)

Argument: (n.) One or more values supplied to a program or command to be used to aid in the processing of that program or command (e.g., TAN(30) returns the tangent value of 30 degrees - "30" is the argument).

Artificial intelligence: (n.) The ability of a machine to mimic the human ability to comprehend and reason.

Assembler: (n.) A program that allows simplified writing of assembly language programs.

Assembly language: (n.) A programming system allowing the use of mnemonic codes to enter machine language instructions into a computer. (See MACHINE LANGUAGE.)

Backup: 1. (n.) A second or third copy of a disk containing information for use by the computer. 2. (v.) The process of making a copy of critical information to minimize the possibility of loss.

Background color: (n.) The main color of the display screen. All other colors, text, or figures on displayed on top of the background color. (See FOREGROUND COLOR.)

Backspace key: (n.) A key used to erase the last character typed. The key is labeled with an arrow that points backwards.

Batch file: (n.) A collection of commands in the form of a file that can be run with a single command, that is, by using the name of the file. The file contains one or more DOS commands in a logical, machine-acceptable sequence. A batch file usually has the extension .bat.

BASIC: (acronym) 1. Beginner's All-purpose Symbolic Instruction Code. A programming language used primarily on microcomputers.

Bell: (n.) A sound from your computer or line printer. Often used by programs to get your attention or to reassure you that computer processing is being done.

Binary: (adj.) Having two possible states or conditions.

BIT: (acronym) A binary digit, 0 or 1, represented in the computer by a "high" or "low" state. (See BYTE, NYBBLE.)

Boot: (v.) The operation of loading the first few instructions into the computer's memory and then using these instructions to start the system. (Source: "Pulling yourself up by the bootstraps.")

Branch: 1. (n.) A departure from the sequential execution of program steps. 2. (v.) Departing from the main program structure to a sub or alternate structure.

Break: (v.) Halting a program in progress through a computer function. This procedure is often disabled by software. The system may have to be shut off to stop the program.

Bug: (n.) An error or malfunction in a program. (See DEBUG).

Buffer: (n.) An area of memory set aside for storage of special data. (e.g. The DOS buffer, which stores input to be used by DOS.)

Byte: (n.) A sequence of eight bits used by the computer as a unit. (See NYBBLE, BIT.)

CAD: (acronym) Computer Aided Drafting.

CAM: (acronym) Computer Aided Manufacturing.

Caps Lock key: (n.) Used to switch the letters A through Z back and forth from upper to lower case. This function affects only letter keys.

Catalog: (n.) See DIRECTORY.

Character: (n.) A single number, letter, or symbol used by the computer. (See BYTE.)

Chip: (n.) An integrated circuit. (See IC.)

Clear: (v.) To restore a storage location, memory device, or display device to its original state.

Clear screen: (v.) Blanks the screen of all characters. Can be done by pressing the Home key while holding down the Control key (Ctrl + Home). (See CLS.)

Clipping: (v.) The process of removing elements of the graphics display that lie outside the defined boundaries.

CLS: (abbr.) The DOS command used to clear the display screen during processing. Internal DOS command.

COM files: (n.) Files with the type extension ".COM," that is, files written in machine language.

Combination key: (n.) A key that must be used together with another key to perform the desired task for you. Combination keys include the Control, Alternate, and Shift keys.

Commands: (n.) Entries that tell the computer what functions to perform.

Concatenation: (n.) The process of combining separate files into one large file.

Console: (n.) The keyboard and the video display of the system. The console is a reserved device recognized by MS-DOS as CON: (or just CON in some applications).

Control key: (n.) A general purpose key with many uses including Break, Pause, System Reset, Clear Screen, Print Echo, and general editing.

CPU: (abbr.) Central Processing Unit. The core of a computer.

CRT: (abbr.) The display screen or terminal of a computer system. Literally, a Cathode Ray Tube.

Cursor: (n.) The moveable marker on a display terminal that marks the location of the next character to be entered.

Cursor control key(s): (n.) Keys used to position the cursor up, down, left, or right.

Cybernetics: (n.) The study of systems that depend on feedback for their proper operation. It includes not only parts of robotics, artificial intelligence, process control and mechanics, but also computer design and operation.

Data: (n.) Any facts, numbers, letters, or symbols that refer to and/or describe an object, condition or idea.

Data base: (n.) A collection of logically related data elements that may be structured in various ways to meet multiple processing and retrieval needs of organizations and individuals.

Debug: (v.) 1. The process of finding, isolating, and removing all malfunctions and errors in a program. (See BUG.) 2. A DOS program used to aid in the writing and maintaining of assembly language programs.

Default: (n.) A value or action that is automatically used by the system unless an alternate value or action is specified.

DEL (abbr.) The key label for the Delete key. (See DELETE KEY.)

Delete key: (n.) A key used to erase the character at the current cursor position.

Diagnostics: (n.) A collection of programs that test for the correct functioning of a computer. Often built in to the computer's ROM.

Digital plotter: (n.) An output device. (See PLOTTER.)

Digitize: (v.) The act of entering data points into a computer's memory either via an automated device or a manual graphic input device.

Digitizer: (n.) An input device. (See GRAPHIC INPUT DEVICE, DIGITIZE.)

Directory: (n.) A list of the files currently stored on a disk or diskette. The list can be displayed by entering the DIR command. Sometimes called a catalog.

Drive specification: (n.) The letters assigned to each drive that enable the computer to identify the drive. You can tell the computer which drive to use (access) by specifying the correct drive letter.

Disk: (n.) A storage device on which information is stored magnetically. (See FLOPPY DISK; HARD DISK.)

Disk drive: (n.) A mechanical device that reads and writes information to the surface of a magnetic disk.

Diskette: (n.) A storage device. (See DISK.)

Display: (n.) An output device. (See CRT.)

Display parameters: (n.) Data that control the appearance of data or graphic entities on the display screen.

DOS: (acronym) Disk Operating System. A program used to read and write data to and from the diskette.

DOS diskette: (n.) See SYSTEM MASTER.

DOS prompt: (n.) A symbol (normally C> or C:\>) that indicates DOS is active and ready to receive commands.

Downtime: (n.) Total elapsed time a system is unusable due to hardware malfunction, software malfunction, or standard "housekeeping" functions.

Dump: (v.) A transfer of information from one piece of equipment to another. (e.g., Computer memory to hard copy).

Double marked key: (n.) See TWO CHARACTER KEY.

DVST: (abbr.) Direct View Storage Tube. A video display that doubles as a memory device for purpose of data output.

Echo: (v.) The process of copying input or output to second or auxiliary device.

EDLIN: (acronym) A program that can be used to create, edit, or display lines of text in a file. EDLIN is often used to create batch files. (See BATCH FILE.)

End key: (n.) Used together with the Control key to erase the screen from the current cursor position to the end of the line (Ctrl + End).

Enter key: (n.) Used to tell the computer that you are finished with a line or area of typing. (See RETURN KEY.)

Entity: (n.) A single element of a graphic display (e.g., a line or a circle).

EOF: (abbr.) End Of File.

Erase: (v.) To remove information from a display device or the computer's memory.

Error message: (n.) 1. A message from the computer to inform you that you have entered something that was not understood by the system. 2. A message from the computer informing the operator of a hardware failure or problem.

ESC: (n.) The key label for the Escape key. (See ESCAPE KEY.)

Escape key: (n.) A programmable key often used as a panic button allowing the operator to abort the current entry or to back up one step.

Extension: (n.) See FILE EXTENSION.

Feedback: (n.) Information, in the form of electrical impulses, sent to a computer or robot, that provides information on the work in progress. Feedback can be in the form of video information (vision), status register flags or many other forms.

Flatbed plotter: (n.) A plotter that draws an image on vellum, glass film, or paper. The media is mounted on a horizontal surface.

File: (n.) An organized collection of information directed toward some purpose.

File extension: (n.) A three character suffix added to a file that often identifies the type of information in the file. An extension must begin with a period.

File maintenance: (n.) The housekeeping tasks associated with caring for or organizing files.

Filename: (n.) A unique name given to a file in order to identify it.

File size: (n.) The number of characters (bytes) needed to store a file on a disk or diskette. MS-DOS displays the size of the files on a disk in the third column of the report generated by a DIR command.

Filter: (n.) A program or command that receives data from an input device, modifies the data, and passes the modified data to a standard output device.

Firmware: (n.) Software that is stored in ROM. (See SOFTWARE.)

Fixed disk: (n.) See HARD DISK.

Floppy disk: (n.) A flexible disk of mylar coated with ferrous oxide (similar to recording tape) used to store computer information magnetically. (See DISK.)

Foreground color: (n.) The secondary color of the display screen. All text or figures are displayed in the foreground color. (See BACKGROUND COLOR.)

Format: 1. (v.) Preparing a medium to accept information (See MEDIA). 2. (n.) The form in which information is presented.

Function key: (n.) One of 10 keys (F1 - F10) that allow special functions to be done with a single user keystroke. Each computer program (DOS, BASIC, others) will use these keys for different purposes.

Game controller: (n.) See JOYSTICK, PADDLES.

Global characters: (n.) See WILDCARD.

Graphic input device: (n.) A device used to enter data points into the computer's memory. (See GRAPHICS TABLET, JOYSTICK, MOUSE, TRACKBALL.)

Graphics tablet: (n.) A flat device, containing a system of wires that is used to input data points via an electronic pen or puck. (See GRAPHIC INPUT DEVICE.)

Grid: (n.) A network of uniformly spaced points on an input or output device.

Hard disk: (n.) A rigid, high-speed storage medium used to store magnetic data for use by a computer system.

Hard copy: (n.) Information printed on paper for human use. (See SOFT COPY.)

Hardware: (n.) The physical equipment that makes up a computer system (e.g., the monitor, the disk drives, etc.).

Hidden files: (n.) The system files IBMBIO.COM, IBMDOS.COM and a file that contains the volume name (if any) not displayed when the DIR command is entered.

Home: (n.) On a display screen, the position in the upper left corner where the first printable character can be placed; often referred to as the initial cursor position.

Home key: (n.) Key used to send the cursor to the home position. Also, if used with the Control key, a clear screen results.

Host computer: (n.) The main computer attached to a network providing services as requested by a user terminal.

Heuristic program: (n.) A general rule or approach used to guide processing and choose among alternatives. Rather than explicitly stating what is to be done in every instance, the heuristic is a rule of thumb that acts as a strategy for solving a problem.

IC: (Abbr.) Integrated Circuit. A photographically produced microscopic electronic circuit.

Indicator light: (n.) A light that illuminates when a particular condition occurs within the computer system. (i.e., if the drive indicator is on when the drive is active.)

Inference engine: (n.) The part of an artificial intelligence program that applies rules to reach conclusions, make choices, or suggest alternatives. The engine provides the method and a separate knowledge base holds the necessary data.

Input device: (n.) One of many types of devices used to enter data into a processing unit (e.g., mouse, puck, graphics tablet, joystick.)

INS: (n.) The label for the Insert key. (See INSERT KEY.)

Input/Output: 1. (n.) The part of the computer that provides a means of communication with the outside world. 2. (n.) An operation that results in the computer accepting or outputting information in some form (e.g., performing output routines).

Insert key: (n.) A key used to tell the computer program that the user wishes to insert characters to the left of the cursor. The insert mode continues once set until the key is pressed again or a key that indicates a different editing operation (cursor arrows, delete, end) is pressed.

Instruction: (n.) A set of commands defining a computer operation that is understood by the CPU or software.

Interface: 1. (n.) A set of commands defining a computer operation that is understood by the CPU or software. 2. (v.) The act of hooking parts of a computer together.

I/O: (abbr.) See INPUT/OUTPUT.

Joystick: (n.) A device used to enter data points into the computer's memory. Also called a game controller. (See GRAPHIC INPUT DEVICE.)

Jump: (v.) See BRANCH.

K: (abbr.) Kilo or 1,000 (i.e., 45K grams = 45,000 grams or 45 kilograms).

k: (abbr.) Two to the 10th power or 1024. Normally applied to the quantity of memory space in a computer system (i.e., 64k = 65,536 bytes).

Keyboard: (n.) Used to input characters, commands, and functions to the computer. The IBM keyboard consists of 83 keys and is organized into three sections called (1) function keys, (2) typewriter keyboard, and (3) numeric keypad.

Language: 1. (n.) A systematic means of providing data or instructions to a computer system using agreed upon conventions (e.g., BASIC).

Library: (n.) A collection of information or symbols available to the computer.

Light pen: (n.) An input device used to input data points via the CRT.

Line printer: (n.) An output device used to produce a hard copy in the form of printed characters or plotted lines.

LISP: (acronym) LISt Processing. The computer language most North American artificial intelligence workers prefer. Language is intended for symbolic rather than numeric processing.

Loop: (n.) A series of repeating instructions.

Lock key: (n.) A key used to cause future key operations to be interpreted in a specific manner by the computer. Lock keys have two states, either on or off, and are switched to on (if off) or off (if on) when the key is pressed. Lock keys include Caps Lock, Num Lock, and Scroll Lock.

Lower-case: (adj.) The lower characters on two-character keys or small letters (a-z).

Machine language: (n.) The set of instructions actually used by a microprocessor to perform computations.

Mainframe computer: (n.) A computer with multi-user and multi-program capabilities; usually valued at greater than $150,000.

Media: (n.) Material on which information is stored (e.g., magnetic disk).

Memory: (n.) The internal working portion of a computer where programs and data are stored and processed. Information remains in memory only as long as the computer is powered up.

Menu: (n.) A list of things displayed on the computer screen that the computer is ready to do. The user indicates the item and the machine performs the indicated task.

Menuplex: (n.) A complex of menus available on a computer or in a program. Often one menu will call several other submenus.

Microcomputer: (n.) A computer with a microprocessor as a central processing unit.

Minicomputer: (n.) A computer with multi-user, multi-program capabilities usually valued at less than $150,000.

Mnemonic: (n.) A word or other device that is intended to aid the human memory; often an abbreviation or acronym.

Mode: (n.) Refers to how a function, which can be set up in several different ways, is set up (i.e., automatic or manual mode.)

Monitor: (n.) See CRT.

Mouse: (n.) A graphic input device used by rolling the device across the top a desk or table.

MS-DOS: (n.) The version of a disk operating system written and owned by Microsoft, Inc. Most commonly used on IBM or IBM-compatible computers. (See DOS.)

Nesting: (v.) The technique of embedding data in levels of other data so that certain routines can be processed continuously, in loops.

Nibble: (n.) See NYBBLE.

Num Lock: (n.) The key label for the Numeric Lock Key. (See NUMERIC LOCK KEY.)

Numeric entry: (n.) The process of entering numbers into the computer. The numeric keypad can be set into a numeric entry mode by using the Numeric Lock key, after which numbers and number symbols (decimals, minus, plus) can be entered.

Number keypad: (n.) One section of the keyboard containing both numeric entry and editing keys.

Numeric Lock key: (n.) The key used to switch the numeric keypad back and forth between numeric entry and editing.

Nybble: (n.) (Also spelled nibble) Four bits; one half of a byte (See BIT, BYTE, NYBBLE.)

Off-line: 1. (adj.) Describes a device that is not under direct computer control (e.g., a data entry machine). 2. (v.) To disconnect a device from the computer's control.

On-line: 1. (adj.) Referring to a device that is under direct computer control (i.e., switching a printer on places it on-line).

Operating system: (n.) The program that allows you to operate your computer. Operating systems that can be used on IBM include MS-DOS, CP/M86, and UCSD p-system.

Output device: (n.) One of many types of devices used to translate information into a readable format (e.g., CRT, plotter, printer).

Paddles: (n.) An input device consisting of two variable resistors that are rotated to select an X-Y position. Similar in operation to a joystick.

Page Down key: (n.) A key used scan down the screen to the bottom of the page. Text on the top moves off the screen while text is added at the bottom.

Page Up key: (n.) A key used scan up the screen to the top of the page. Text on the bottom of the screen moves off while text is added at the top.

Parallel port: (n.) The output connection of a computer that provides information to a parallel output device such as a parallel printer.

Parameters: (n.) Data that control the operation of a computer system; often used to modify default conditions.

Parse: (v.) To analyze the structure of a statement; particularly to break down a complex linguistic statement into basic units for further processing.

Parser: (n.) A program that performs the operation of parsing. (See PARSE).

Path: (n.) The unique route that DOS follows to find a specific command or file name. The path consists of a series of subdirectory names separated by backslashes (\). The path search begins at the current directory unless the path specification begins with a slash in which case the search begins at the root directory.

Pause: (n.) A computer function that can be used at any time to temporarily halt the program in use. Pause is caused by pressing the Num Lock key while holding the Control key down (Ctrl + Num Lock). Pressing any key after a pause causes the computer to continue from the point of interruption. Pause can also be performed with one hand by pressing the key combination Ctrl + S.

PEL: (abbr.) Picture ELement. (See PIXEL).

Peripheral Device: (n.) Any piece of hardware that is not the computer itself (e.g., the printer.) (See HARDWARE)

Piping: (v.) The process of using the output of one program as the input of another. Allows chaining of program with automatic redirection of results. The vertical bar (:) is used to instruct DOS to perform piping operations.

PIXEL: (Acronym) A single dot of light on a graphics display; a single picture element. ("PIX" ELement).

Plotter: (n.) Device that draws a hard copy using pens based on information supplied by the computer.

Print Echo: (command) This function is performed by pressing the Print Screen key while holding the Control key down (Ctrl + PrtSc). Once this key combination is pressed, whatever is printed on the screen is also printed on the printer. The simultaneous printing (screen and printer) continues until the key combination is pressed again. Print Echo also can be performed using the key combination Ctrl + P.

Print Screen: (command) A function caused when the Print Screen key is pressed while holding the Shift key down (Shift + PrtSc). Once this key combination is pressed, the information on your screen display is printed on the printer.

Print Screen key: (n.) A key that can be used with the Shift key to produce a Print Screen or with the Control key to produce a Print Echo.

PROLOG: (N.) A computer language used in artificial intelligence work that focuses on logical relationships among objects. Stands for PROgramming in LOGic.

Program: 1. (n.) A set of ordered instructions that causes the computer to perform a particular task. (See also SYSTEM PROGRAM, APPLICATION PROGRAM, UTILITY PROGRAM.) 2. (v.) Writing and installing a set of instructions into a computer.

Programming language: (v.) A special means of providing instructions to the computer to get it to perform a specific task. Examples of programming languages include BASIC, COBAL, PASCAL, and FORTRAN.

Prompt: 1. (n.) A message or device that instructs a user that it is ready to accept input. 2. (v.) The act of informing a computer that the user is ready for instructions or output.

PrtSc: (abbr.) The key label for Print Screen key.

RAM: (acronym) Random Access Memory.

Raster scan: (n.) A type of video display created by a ray exciting phosphor dots on a CRT by scanning in horizontal lines (usually 524 lines).

Read: (v.) The act of transferring information into a computer from permanent storage or media.

Record: (n.) A single line in a data base; contains complete information pertaining to a single entry.

Repaint: (v.) The process of redrawing the screen display to reflect its updated status.

Return key: (n.) Used to tell the computer that you are finished with a line or area of typing. (See also ENTER KEY).

ROM: (acronym) Read Only Memory.

Root directory: (n.) The default listing of files on a disk or diskette. When a disk is formatted, a single directory is created. The root directory contains the names of all the files at the top of a tree structure in addition to the names of any subdirectories in the next level of the structure.

Screen: (n.) See CRT.

Scroll Lock key: (n.) A key not used much in current programs; intended for use as a lock type key which would cause displayed text, not the cursor, to move when a cursor control key is pressed.

Sector: (n.) A wedge-shaped portion of a track on a disk or diskette. Used by DOS to aid in the location of the information on the disk. MS-DOS divides each track into eight or nine sectors on a floppy disk and 17 sectors on a hard disk.

Self-test: (n.) 1. The initial test that the computer performs upon start-up that makes certain all parts of the computer are working correctly. Also available on a printer upon request. 2. (v.) Performance of a self-test operation.

Serial port: (n.) The output connection of a computer that provides information to a serial output device (e.g., a serial printer.)

Shift key: (n.) The Shift key is used to select the upper case character on keys labeled with two characters. The Shift key also works together with the Caps Lock key. Using the Shift key together with letters A thru Z reverses the case (as determined by the last press of the Caps Lock key).

Soft copy: (n.) Information as displayed on a CRT or stored in a computer's memory. (See HARD COPY.)

Software: See PROGRAM.

Source diskette: (n.) The diskette that contains the information to be copied, moved, or modified.

Source drive: (n.) The drive that contains the source diskette. (See SOURCE DISKETTE, TARGET DRIVE.)

Source program: (n.) A sequence of instructions written in assembly language or a high level language such as BASIC.

Store: (v.) Transferring of information to a permanent storage device or medium.

Subdirectory: (n.) Any directory that is not the root directory. A subdirectory is displayed as a file name without an extension but is marked as a directory such as LOTUS <DIR> (See ROOT DIRECTORY).

Syntax: (n.) The structure required for a particular computer command.

System program: (n.) A program that makes the power of a computer available for general purposes. System programs are usually invisible to the user. The output of a system program is computer-oriented. (See APPLICATION PROGRAM and UTILITY PROGRAM.)

System Reset: (v.) A system function that restarts the computer just like an on/off switch. This function is accomplished by pressing the Delete key while holding the Control and Alternate keys down. Three keys are used to make sure you know what you are doing and to avoid accidentally resetting the system.

Tab key: (n.) This key is used for setting automatic spacing for typing input. The Tab key has both a forward and backward capability.

Target diskette: (n.) The diskette that is to receive transferred, copied, or modified information.

Target drive: (n.) The drive that contains the target diskette. (See TARGET DISKETTE, SOURCE DRIVE).

Template: (n.) An area of memory that MS-DOS uses to store the last line or command entered. Characters in the template can be recalled in various ways using the line editing keys (F1 - F5).

Toggle key: (n.) A key with two states, either on or off, that causes subsequent key operations to be processed in a predetermined manner. Toggle keys include Caps Lock, Num Lock and Scroll Lock. (See LOCK KEY.)

Track: (n.) A circular path on magnetic media along which information is recorded. Tracks are subdivided into sectors. (See SECTOR.)

Trackball: (n.) A device consisting of a ball that is rotated by pushing to cause a variation in the X-Y data entered into the computer's memory. (See GRAPHIC INPUT DEVICE.)

Tree structure: (n.) The relationship of the root directory and all subdirectories. The relationship can be displayed using the TREE command in MS-DOS.

Truncate: (v.) The process of deleting (ignoring) any illegal or unnecessary characters or numbers. To cut off or drop.

Turnkey: (adj.) Pertaining to a computer system in a ready-to-use state. User can simply turn computer on and begin work.

Typewriter keyboard: (n.) One of the three main key groupings that contains the standard QWERTY typewriter keyboard plus some additional special keys including Enter, Backspace, Tab, Escape, Alternate.

Two-character key: (n.) A keyboard key with both an upper case and lower case character or with two symbols or functions. Often called a double-marked key.

Upper-case: (adj.) The upper characters on two-character keys or capital letters (A-Z). Upper-case characters can be typed by holding the Shift key down while pressing the desired key.

User: (n.) The person who actually uses the computer system to perform a specific job.

Utility program: (n.) A program that simplifies housekeeping of a computer system. (See APPLICATION PROGRAM and SYSTEM PROGRAM.)

Vector-refresh: (n.) A type of video display created by a ray-exciting phosphor on a CRT by actually drawing the line from point to point.

Video monitor: (n.) See CRT.

Viewport: (n.) An active subdivision of a window.

Volume label: (n.) The name of a disk or diskette displayed by a DIR command. The volume name is assigned while formatting.

Wildcard: (n.) A character used to tell MS-DOS that any character can occupy a specific location by substituting a question mark or all remaining positions by substituting an asterisk. Often called global characters.

Window: (n.) One of the subdivisions into which a computer screen may be divided.

Word: (n.) An ordered set of bits that represent one character.

Working copy: (n.) A copy of a diskette that is being used instead of the original copy. This prevents the original from being accidentally damaged.

Write: (v.) See STORE.

Write-enable notch: (n.) A small notch on the left side of a diskette that when uncovered allows information to be written on the diskette. When covered by a write protect tab, writing to the disk is mechanically disabled. (See WRITE PROTECT, WRITE PROTECT TAB.)

Write protect: (v.) The act of covering the write enable notch on a diskette with a write protect tab in order to prevent accidental damage or erasure. (See WRITE ENABLE NOTCH, WRITE PROTECT TAB.)

Write protect tab: (n.) A small piece of tapelike material placed over the write-enable notch to create a write-protected disk. (See WRITE PROTECT, WRITE ENABLE NOTCH.)

Zoom: (v.) The act of modifying the scale of an area of the display to better examine the details.

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